What's ahead

It Won't Be Long Now!

It's already time to be making those plans for coming to the Chem. Show — all primed with your production problems and questions on how and where to find what you need when you need it. *Chem. & Met.* will help you out next month with an exhaustive preview of the really new equipment and materials that are to be on display here in New York in December. And, in addition, we promise you a real treat in the fourth of our series on outstanding chemical engineering achievements. (See page 606 for the name of the winner of the 1939 Award!)

All in all it looks like you've got something coming to you! Watch out next month for *Chem. & Met.'s* biggest effort of the year — its Seventeenth Chemical Exposition Number.

•

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CHEMICAL & METALLURGICAL ENGINEERING

Volume 46 — Established 1902 — Number 10

OCTOBER 1939

Once more the first Monday in December will usher in a week of intense chemical activity at New York's Grand Central Palace where the 17th National Exposition of Chemical Industries will take place. More than 45,000 chemical engineers and other interested persons will make their biennial trip to this familiar building located uptown on Lexington Ave. *[Cover space released for editorial use by the Pfaudler Co.]*

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ESTABLISHED 1902

OCTOBER, 1939

S. D. KIRKPATRICK, *Editor*

More Planning—Less Secrecy

Disturbed conditions abroad and their backwash in the United States are beginning to be felt in many of our industries. Some find their raw material supplies threatened or actually cut off. A few find their foreign markets gone or beyond reach. Others find new demands in Latin America, with complicating problems of credit and shipping. All are confronted with changes in costs that have resulted from chaotic bidding for labor and supplies. Now, before it is too late, industry has a job of planning that it simply must do.

The prime objective in most of this planning should be stabilization of business. It will be far better, and in the long run far more profitable, to seek stability rather than quick increases in volume or rapid rise in prices. Chemical manufacturers, who have attempted to stabilize their prices and have urged their customers to avoid the pyramiding of inventories, are doing a real service to the country as well as to themselves.

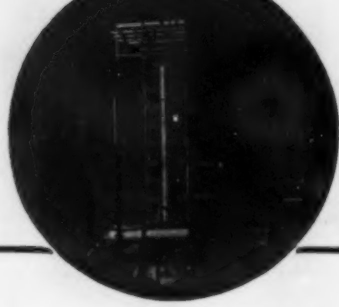
There is another lack of planning in certain quarters that is strangely reminiscent of the mad days that preceded America's entry into the first World War. Then we were engaged in a frantic attempt to make our own dyes and medicinals, explosives and other chemical products. There was costly duplication of effort in some directions and equally costly neglect of other opportunities. There was a wild scramble for chemical engineering equipment and laboratory supplies. As a matter of fact, the very first National Exposition of the Chemical Industries was held in 1915 primarily to help to answer the how-and-where-to-find-what-you-need-when-you-need-it questions. This year there is an even greater need for the Chemical Show to serve as a clearing house for information on new products and new equipment.

With that in mind we want to sound a note of warning against what seems to be a dangerous trend toward excessive secrecy, particularly in chemical industry. During times of change there is always a tendency to "hush-hush" about all company developments. In a very limited number of cases where matters of national defense are concerned, this is undoubtedly justified. But far more cases will be harmed by secrecy rather than helped.

Suppose, for example, that a company is embarking rapidly on a new manufacturing project, hoping to supply American customers with some chemical previously imported. Take potassium sulphate for fertilizing tobacco or potassium chlorate for manufacturing matches. Several firms have been quietly looking into these possibilities and it is rumored that some new plants are soon to get under way. The natural tendency on the part of the manufacturer is to keep that fact secret. He thereby most harms himself. His potential competitors do not know that he has embarked on the new program. They too rush ahead—probably with equal secrecy. Suddenly it is discovered that two or three times as many companies with perhaps two or three times the needed production capacity are fighting for business where most of them might be developing even more attractive opportunities in other lines.

No one has the right nor would be silly enough to ask that every executive decision of every company be immediately published. But prompt publicity for new plant construction and plans for new products may well prove a constructive influence for all concerned. These are times when it will be an advantage to purchasers to know well in advance where they can expect to get newly made materials to replace imported goods or to fill a new market. It will be a protection to the producers themselves if they announce their plans promptly to the industry.

Let there be sound planning for stabilization as well as progress. And let there be reasonable publicity about it where it affects the public interest.



From an

CHEMICAL ENGINEERING MARCHES ON!

FOR ITS MANY and continued contributions to the advance of the petroleum industry, the Standard Oil Development Co. is to receive the 1939 Award for Chemical Engineering Achievement. In the opinion of the Committee of Award, which consists of nine recognized leaders of the chemical industry and profession, the outstanding development of the past two years has been the application of chemical engineering principles and methods in the large-scale production from petroleum hydrocarbons of new aviation fuels and other valuable products of chemical synthesis.

It is significant that this is the first award for distinguished group effort in chemical engineering to go to a technical organization outside of the strictly chemical industry. This large and productive group of more than 500 chemists and engineers pioneered in the development and application to petroleum refining of high pressure hydrogenation and other catalytic methods. Thus was built a foundation and background of experience that has made it possible to make many rapid advances in changing petroleum refining into an organic chemical manufacturing industry.

Next month it will be our privilege to present in greater detail the story of this achievement and what it means to the chemical engineering profession.

BLOCKING PERSONAL PROGRESS

IN GENERAL we have been sympathetic with the idea that the technically trained man who wants to make his career in the production side of chemical industry should be encouraged to take a subordinate job in the operating department. We have all seen such men rise rapidly to positions of greater responsibility as their ability and training are felt and appreciated by management. Now we find, to to our surprise, that sometimes this line of progress is being blocked by union agreements that have been dictated entirely by the entrenched interests of organized labor.

Promotion in some chemical plants is controlled on the basis of arbitrary rulings on departmental seniority so defined as to handicap seriously the youngster who has spent at least four years in fitting himself for the job higher up. Such a situation is described by our correspondent, J. N. B., whose letter appears on page 645 of this issue.

Plant managers, who are sincerely interested in the development of their younger engineers and technically trained men, should be warned against signing any union agreement that curtails the opportunities for progress and promotion on ability. In turn, the young engineer in taking an operating job should make sure that he is not burdening himself with an unnecessary and impossible handicap in his climb up the ladder.

WHERE ANGELS FEAR TO TREAD

SOME AMERICAN chemical manufacturers are beginning to look covetously at some $400,000,000 of export trade that was enjoyed last year by Germany and Great Britain. They are tempted most by the sizeable slice of more than $100,000,000 of business that has been going to Latin America, almost under our very noses. Forgetting the lesson that should have been learned 25 years ago, some of these go-getting business men are going to rush in and grab off their share while the grabbing is good. And, the foreign trade experts estimate that about 90 per cent of them will probably lose their shirts unless they get experienced help and advice.

Even those manufacturers who have had most experience in foreign trade are having their troubles in readjusting their business to today's rapidly changing conditions. Foreign countries are daily imposing new restrictions on commercial transactions. Shipping is so badly disrupted that at the present moment less than half of the bottoms usually engaged in foreign trade are available although Washington promises improvement soon. Insurance rates are going sky-high, despite governmental offerings. And the steadily growing British blacklist, which in the last war contained thousands of names of chemical and related companies, is a threat one cannot disregard, especially if he wants to continue to do business with British subjects, including our good neighbors to the North.

All this adds up to the need for caution in approaching what may well be the greatest opportunity we shall ever have to build up our commerce with South America. Let's make sure we don't fumble it as we did during and immediately after the World War. Let's lay the foundation now for exchange of goods which will continue and grow regardless of the outcome of the war in Europe. It means careful study and intelligent cultivation of

Editorial Viewpoint

markets that cannot be supplied by haphazard or high-pressure methods. Chemical manufacturers will be well advised to proceed slowly and deal only with experienced and substantial agencies.

STOCK-PILE POLITICS

THE NAVY DEPARTMENT is spending almost a half-million dollars to buy tungsten ore from a domestic source which is reported to have sold the ore from its own stock-pile reserves in Nevada. The Navy paid \$25 per short ton unit (20 lb. of tungsten oxide per unit) for 17,250 units. The competing bid, which was rejected, offered nearly an equal amount at \$15.75 per short ton unit, c.i.f. New York harbor, but without duty. To interpret its acceptance of the higher price, the Navy explains that it had to add the duty of \$7.93 per unit and had to take account of the "Buy American" provision of the law.

Purchase of the Chinese tungsten offered for import would have increased the available supply within this country by whatever amount was purchased. The money being paid for the Nevada production would have bought nearly 60 per cent more of this strategic mineral than will be purchased under the accepted contract. The Nevada offer added nothing to available supplies. It simply transferred ownership of the goods to Uncle Sam and took funds out of the Treasury for the purpose.

It should be remarked that Representative Scrugham of Nevada sponsored the bill that provided the funds for the Navy's purchase. He is also a member of the House Appropriations Subcommittee which passes on all Navy appropriations. It is indeed unfortunate if our legislators are playing politics in building up the stock-piles needed for our national defense. They may have some embarrassing questions to answer. Certainly they will have a real responsibility to the American public if they impose any plan that puts the selfish interests of their constituents above the Nation's welfare.

ABUNDANT POTASH

CERTAIN GOVERNMENT officials have shown surprising inconsistency in their attitudes and actions toward the American potash industry. On the one hand they have accepted a self-designated credit for the fact that the domestic producers are going to be able quite readily to supply American needs for this essential of fertilizer and chemical industry. Then, almost simultaneously, the same spokesmen of the Interior Department announce that they are going to offer six more parcels of public land so that they may create additional competition with present potash companies at this very crucial time. The offering of these six potash parcels in California seems an ill-conceived, if not unfair and unpatriotic action by the Interior Department.

It should not be forgotten that there is more involved in the question of potash supply than the mere digging of more mineral out of the Carlsbad mines or the processing of more brines at Trona. These natural potash minerals will not care for all the American needs without further development of new processes. It will be essential, for example, to convert some of the domestic supply into potassium sulphate since only that potash chemical is acceptable for tobacco fertilizers. This means a lot of new technical work, new capital risks, and intensive development of plans just at the time when the same companies are busy with mining operations of the primary sort. It seems a poor time to confront this industry with a set of new competitive troubles.

No one will quarrel with the government for the credit it deserves in helping to discover and explore the potash deposits of New Mexico. The U. S. Geological Survey and the Bureau of Mines did a commendable job in that respect. But the benefits gained should not be offset by any ill-timed effort "to promote competition." There is plenty of competition now and will be more. Mr. Ickes need not worry on that score. He should let the technical men and not the politically-minded individuals of his department advise him on these points.

THE TARIFF TINKERS

WASHINGTON hears frequent discussion regarding further trade agreement negotiations. Sometimes it makes one wonder if officials have lost their sense of humor when they talk about a new trade agreement with Belgium. Can anyone assume that such a trade agreement could be negotiated with the consent of the Belgians? Can anyone assume that he knows how such trade agreement ought to be arranged for conditions even six months ahead?

The State Department could contribute a real service to many lines of industry if it would announce that tariff tinkering would not be undertaken in the immediate future.

Making Explosives Then and Now

In this double-barreled article Dr. Berl first reviews his many interesting experiences as a chemical engineer in charge of making munitions for the Central Powers in 1914-1918 and then outlines the position of the United States in regard to the manufacture of explosives in 1939

Part I.

Recollections Concerning the Austrian Munitions Industry, 1914–1918

NOW THAT MANY of the nations of Europe are again embroiled in a great conflict, the writer finds the situation reminiscent of the early days of the first World War. He was an Austrian chemical engineer called to the cause on the first day of the war, August 1, 1914. Although a lieutenant in a heavy artillery regiment, he was immediately assigned to the government explosives plant at Blumau, about 25 miles southwest of Vienna.

Chemical and mineral resources of the Central Powers during the last World War were often found near the borders—especially in Austria-Hungary

There had been no preparation for war. Rayon and other plants had to be converted into munitions factories. In November 1914 a new organization had to be set up to construct new plants for raw and intermediate materials for the production of explosives. It is not generally known that the war would have ended rather soon for lack of nitric acid, which at that time was the basis of about 95 per cent of all explosives, if 50,000 metric tons of Chile saltpeter had not been found in warehouses captured at Antwerp. If this had been thrown into the River Schelde, a simple enough task, the Central Powers would have been forced to end the war in the spring of 1915. This amount of sodium nitrate enabled the Central Powers to overcome the difficult months from the spring of 1915 until the fall of that year when the nitrogen plants really could begin producing nitrogen compounds in constantly increasing quantities.

There is no doubt that in that great war the raw material situation and the number and size of technical installations which could transform the raw materials into final products decided the final result. The production of coke, pig iron and steel in 1912 for the Central Powers, the Entente and the United States of America is given in the following table:

ERNST BERL, *Research Professor,*

Carnegie Institute of Technology, Pittsburgh, Pa.

PRIOR to the World War Dr. Ernst Berl was an Austrian chemical engineer. He was born in a small town then a part of Austria, later a part of Czechoslovakia and now a part of Germany. Joining his regiment on August 1, 1914, as a lieutenant in a heavy artillery regiment, he was immediately placed in an explosives plant at Blumau, Austria. Here his previous experience in the production of cellulose nitrates for nitro rayon stood him in good stead.

Very shortly Dr. Berl became virtually the head of the entire Austro-Hungarian munitions industry under the title "Chief Chemist of the Austro-Hungarian War Ministry." Throughout the war he was called upon to solve many difficult problems in order to keep the supply of explosives flowing.

After the war Dr. Berl came to the United States to become a research professor at Carnegie Institute of Technology. Now an American citizen, he views the present European conflict with a detachment born of time and distance. His recollections of the First World War may be both interesting and useful to engineers and chemists seeking to interpret this second conflict. His summary of American raw material sources in their relation to explosives manufacture, presented in Part II of this article, will prove both reassuring and instructing in any consideration of possible eventualities.—EDITOR.

Coke Production—1912 (Millions of tons)

Germany	29
Austria Hungary	2.5
Total Central Powers	31.5
Entente	29
United States	40

Iron Ore—1912 (Millions of tons)

Germany	34
Austria Hungary	5
Total Central Powers	39
Entente	41
United States	56

Steel Production—1912 (Millions of tons)

Germany	17
Austria Hungary	3
Total Central Powers	20
Entente	19
United States	32

It can be observed that prior to the entrance of the United States into the war, the supplies of strategic raw materials in the two enemy camps were practically equal. However, American participation gave the Allied Powers an immediate 150 per cent superiority.

The map shown on this page will throw some light on the general availability of raw materials in Austria, Hungary and Germany during the great war. In Germany the principal raw material and ammunition plants were to be found in the western part of the country. Aviation had not been developed at that time as it is today, and with the exception of a few isolated cases, there was no immediate danger for those plants. However, the Austrian raw material sources were to be found principally on the periphery of the monarchy. During the first year of the war, the Galician oilfields were in Russian hands. The Russian Cossack patrols were only 40 miles distant from the important coal districts of Silesia. The fact that the raw material sources were situated on the borders of the country and were endangered by this position was naturally not unknown to the War Ministry. Consequently, since the factories which turned out the final product could not be exposed to the hazards of war, it was decided to place them in the center of the monarchy—near Vienna, which was difficult to reach at that time. The government's powder plant at Blumau, of which the writer was manager after the collapse of November, 1918, was the largest explosives plant in Europe. It consisted of eight large factories, employing 25,000 men at the beginning of November, 1918.

Seen from an Austrian point of view the great war can be divided into three parts—the first began with the declaration of war and ended in May 1915 when the Russian front was broken through at Gorlitze, Galicia, by the inspired plan of the commander-in-chief of the Austrian army —Konrad von Hötzendorf; the second period began in 1915 and lasted until the middle of 1916; the third period lasted from that time until the end of the war. If in comparing the explosives production throughout these periods, we assign to the first period a production value of one unit, the second period amounted to two units, and in the third period there should have been five units. However, this latter was a goal not altogether attained. The reason for the increased requirement for explosives was the change over to heavier caliber firearms as will be noted in the following table:

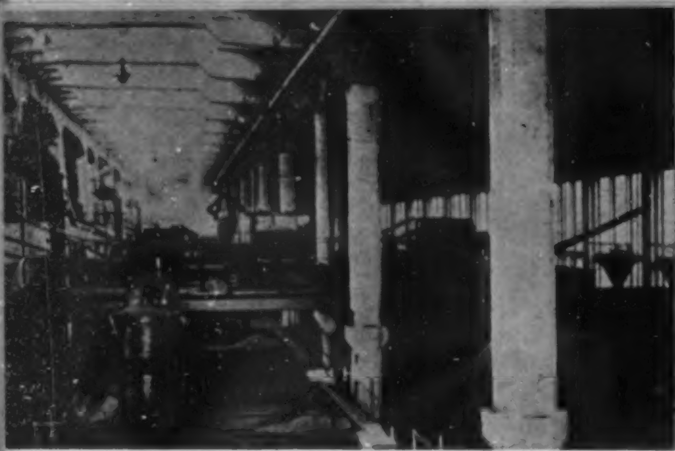
Powder Requirements of Various Guns

Gun	Propelling Charge, kg.	Shell Charge, kg.	Total per Shell kg.
7.5 cm. Field gun	0.55	0.66	1.21
15 cm. Howitzer	1.3	5.8	7.1
15 cm. Cannon	12.4	6.2	18.6
30.5 cm. Mortar	13.7	38.0	51.7
35 cm. Cannon	193.0	70.0	283.0
42 cm. Howitzer	55.0	98.0	153.0

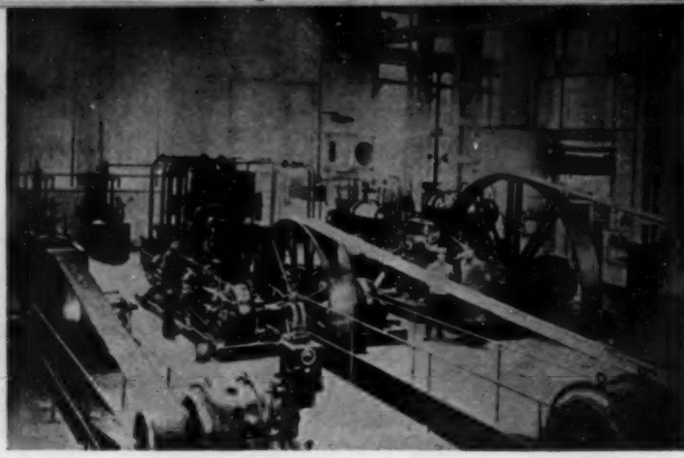
In the first period there were sufficient raw materials, but not enough factories, while during the third period there were insufficient quantities of raw materials, but enough factories. One found one's self, so to speak, in a fortress consuming the supply on hand without being able to replace it with new material.

It is a fact that subsequent wars will require much larger quantities of explosives than were needed during the World War. Though David required only one projectile to render his opponent, Goliath, defenseless, statistics show that in 1914–18 it took 400 artillery projectiles to kill, and 80 projectiles to wound an opponent. In order to destroy one armored turret of the Fort of Antwerp, it took 122 tons of projectiles. Greater range and better camouflage necessitated enormous quantities of explosives. Twelve thousand shots were necessary to destroy a low-flying airplane. It may, furthermore, be interesting to note that when St. Mihiel was captured the American troops shot more ammunition in four hours than was used during the whole Civil War.

At the beginning of the war the



Photos printed on this and following pages are taken from the pages of Dr. Berl's album of World War shots. This one shows an oleum plant (Mannheim) built to use Alpine pyrites



This large Linde installation was used for the production of 99.5 per cent nitrogen, which was subsequently ground with finely divided calcium carbide to make calcium cyanamide

heavy artillery of the Central Powers was stronger than that of the opponent. Twenty-five years ago the motorization of artillery was almost unknown. Only the Austrian 30½ cm. (12-in.) mortar piece was motorized and it followed the troops with the speed of the cavalry into the front trenches. An ingenious platform made it possible to bring the mortar quickly into firing position. In view of the strong motorization of all armies since that time and the enormous development of war in the air, tremendous amounts of oil will be required in the present and future conflicts. Experiences in Ethiopia, China and Spain seem to indicate that a great country entangled in a general war would now require at least 20,000,000 tons (about 140,000,000 bbl.) per year of oil products for military purposes.

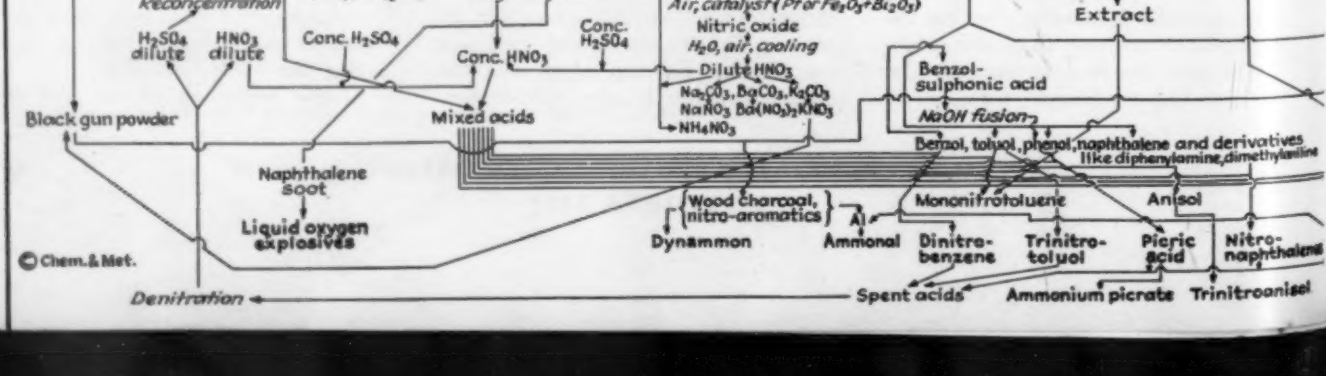
Chemicals also have become increasingly important as war materials. Aside from primitive experiences during previous wars, the gas attack and defense was first introduced systematically during the World War. Historically speaking, the French were the first to use small shells filled with chemicals. However, the first great gas attack took place on April 22, 1915 at Ypres by the Germans. Chlorine was blown from about 6,000 steel flasks upon a front of 7.5 miles and many Englishmen were either killed or put out of action. A few weeks later a similar attack was made at the Russian front. While blowing off the chlorine here, however, the west wind changed to an east wind and the chlorine gas was blown back into the German ranks causing enormous damage. This led to the construction of gas masks and to the production of projectiles filled with poisonous gases, so that the aggressor could become more or less independent of the strength and direction of the wind.

Because the raw material situation was vitally important as pointed out above, a great amount of technical work was required to put the munitions industry on a war-time footing. Numerous plants had to be built and new processes developed. Some of the more important plants built at that time will be described in the following paragraphs.

Oleum—One of the first plants built was an oleum plant, constructed according to the so-called Mannheim system. Pyrites discovered in the Austrian Alps at an altitude of 12,000 ft., and containing some copper, was used as raw material. German pyrites from Meggen containing larger amounts of zinc blende and fluoride also had to be used. This material was difficult to handle. At that time the separation of pyrites from blendes by a flotation process was not yet invented. Since the Mannheim process used iron oxide and platinum as a catalyst, the oleum produced by the iron oxide catalyst contained iron salts and therefore could not be used for the production of picric acid. About 40 per cent of the sulphur dioxide was converted to sulphur trioxide over asbestos covered with platinum. This oleum was free of iron compounds. Part of this 20–30 per cent oleum was distilled to furnish 60 or 100 per cent oleum for use as smoke screens. This way of producing artificial fog proved simple and efficient.

Of great importance were the installations for the reconcentration of sulphuric acid formed as a byproduct of the nitration of glycerine and of aromatic compounds such as toluene and phenol. In view of the very limited amounts of sulphur which were available, this reconcentration apparatus played an important role, and the production of explosives was lim-

This "family tree" shows how explosives were made in 1914-1918. Raw materials are listed across the top while finished



Platinum catalysts in these converters changed ammonia into nitric oxides with efficiences up to 92 per cent. Later the use of Haber-Bosch ammonia boosted this yield slightly

ited for a certain length of time because of insufficient equipment in these plants.

Nitric Acid—At the beginning of the war nitric acid was made from Chilean sodium nitrate and sulphuric acid by the classical process. However, in February 1915, the construction of a huge plant for the conversion of ammonia into nitric acid and various nitrates was started. This plant began operations six months later. The required ammonia was obtained partly from the decomposition of ammonium sulphate from coke oven plants and partly from calcium cyanamide.

Ammonia from this source was converted into nitric oxide over a platinum catalyst with yields as high as 92 per cent. This compares with 96 per cent for the combustion of ammonia made later synthetically by the Haber-Bosch process. Stainless steel was not obtainable at this time in large sizes; so neither the conversion of nitric oxides into nitric acid under pressure nor the combustion of ammonia with air or oxygen under pressure could be carried out.

One of the great difficulties encountered was the dissipation of the large amount of heat resulting from the conversion of nitric oxide to nitric acid. More than 30,000,000 B.t.u. per hour had to be eliminated by cooling the circulating, absorbing nitric acid.

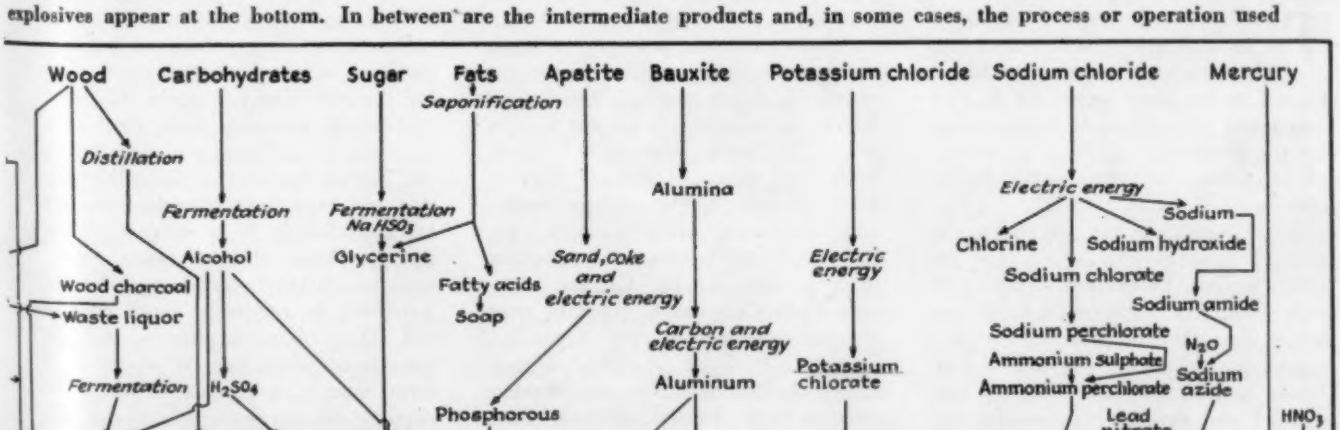
Most of the resulting nitric acid was concentrated with sulphuric acid according to a process invented by H. Pauling. In a rather small diameter packed column of considerable height, the mixture of strong sulphuric acid and 54 per cent nitric acid was denitrated with steam. The resulting nitric acid was practically water-free. This part of the installation worked very nicely, but there was one great difficulty. The resulting 72 per cent sulphuric acid had to be reconcentrated and when it was not completely denitrated, it attacked very quickly the cast iron boiler containing about 15,000 lb. of concentrated sulphuric acid.

Glycerine Trinitrate—The nitration of glycerine was done in the old classical way using nitration apparatus made from lead. At the end of the second year of the war it could be seen that because of the lack of fats, production of glycerine from this source would soon be insufficient. Glycol which served as a substitute for glycerine, could not be made because large amounts of ethylene were not available. However, successful experiments with nitroisopropyl glycerine made from formaldehyde and nitromethane were carried out. Both of these raw materials could be made from natural gas found in Transylvania and chlorine produced there. Meanwhile, a fermentation process was introduced, invented by Neuberg and Connstein. Through the fermentation of sugar to which sodium sulphite had been added, sufficient amounts of glycerine could be formed. This glycerine was separated from inorganic components and used exclusively during the last two years of the war for production of artillery powder. The necessary amounts of pure sodium sulphite were produced in the oleum plant by an intentional reduction of the conversion of SO_2 into SO_3.

Cellulose Nitrates—In the last two years of the war, 100 lb. of cellulose in the form of thin sheets made from wood pulp (cotton linters were not obtainable) could be nitrated in one operation giving a yield of 160 lb. or more of cellulose nitrate. This installation gave excellent results. Burning of charges occurred very seldom. The consumption of nitric acid (which was so important at this time) could be reduced more than 35 per cent by a special treatment of the cellulose nitrate. Stabilization of this nitrocotton was made in the usual way by decomposing mixed sulphate-nitrates and nitrates of lower carbohydrates with the combined weak acid and weak alkaline treatment. Since that time the writer has worked out quicker and more efficient methods of stabilization.

Ammon Powder—During the last year of the war when the amount of nitric acid was quite insufficient, an Austrian invention called "Ammon

explosives appear at the bottom. In between are the intermediate products and, in some cases, the process or operation used



powder" was produced. This Ammon powder was composed of ammonium nitrate, wood charcoal and some aromatic nitro compounds and it could be produced very easily. It had the disadvantage that, due to the conversion of ammonium nitrate into other modifications at somewhat elevated temperatures which existed in Palestine and Turkey, pieces of powder broke and caused great trouble in the guns.

TNT—Large amounts of trinitrotoluene had to be produced according to the well-known nitration process. Toluene produced from aromatic hydrocarbons obtained by the coke-oven process, was not sufficient to cover the great need. Considerable amounts of these aromatic hydrocarbons could be made from the distillation of so-called "light oil," a solution of aromatic hydrocarbons washed out from city gas with high boiling mineral oil. Also in the crude oil of Galicia and Rumania rather large amounts of aromatic hydrocarbons were present which were extracted with liquid SO_2 using the Edeleanu process, as suggested by the author.

The oil extract was then refined so that a certain fraction containing 60 to 70 per cent toluene and 30 to 40 per cent of hydro aromatic hydrocarbons with the same boiling point as toluene was obtained. This mixture was nitrated so that the toluene was converted to mononitrotoluene and the hydro aromatic hydrocarbons were not attacked. It was easy to separate the higher boiling mononitrotoluene from saturated hydro aromatic hydrocarbons and to trinitrate the partially nitrated toluene. TNT obtained in this manner showed a higher melting point than that obtained from a coal toluene. Part of the TNT had to be recrystalized and this was done with alcohol-benzene. A special heat treatment of the raw TNT allowed the raising of the melting point without using the costly recrystallization or the sulphite extraction processes.

Picric Acid—Large amounts of other aromatic nitro compounds were made by the nitration of phenol. Part of these phenols were produced from the distillation products of bituminous coal. Other parts were made synthetically by the sulphonation of benzene. Synthetic phenol was, of course, purer than the phenol made from coal distillation products. A difference in the nitration properties could not be observed.

Nitration of these phenols was carried out in steel vessels by forming phenol di- or trisulphonic acids with oleum and nitrating afterwards under such conditions that the steel was not attacked. In this way picric acid could be obtained practically free of heavy metals. For most purposes, picric acid was used in the form of a lower melting eutectic mixture with 10 per cent mononitronaphthalene. For certain special purposes picric acid of larger crystal size had to be produced. This was done by crystallizing picric acid from a solution in nitric acid. On one occasion by an unhappy accident, about 4,000 lb. of picric acid—partly in suspension in nitric acid, partly in form of crystallized material—exploded and 35 men lost their lives. No trace was found of the five persons who were in the crystallization room at the time of the accident.

Many other special products such as potassium, barium and strontium nitrates, hydrogen peroxide, activated carbon, etc., were produced. Their production did not present any special difficulties. The increased use of activated carbon, hydrogen peroxide and many sera was responsible for the fact that fewer men died from disease in this than in previous years.

The writer could continue for hours to describe problems with which he was and had to be concerned from August 1, 1914 until March 25, 1919. He wishes to forego the drawing of either ethical or other conclusions regarding this difficult but interesting time. He tries to explain such happenings from a scientific point of view. He sees in the war a powerful catalytic reaction which hastened a slowly proceeding reaction. He does not venture to say whether this reaction is one which will in the end serve humanity, or whether it is a reaction which will have the opposite effect. However, one fact cannot be denied. The single individual cannot escape this cataclysm. He must do his duty, enhance the good and minimize the evil in such a situation, to the best of his ability.

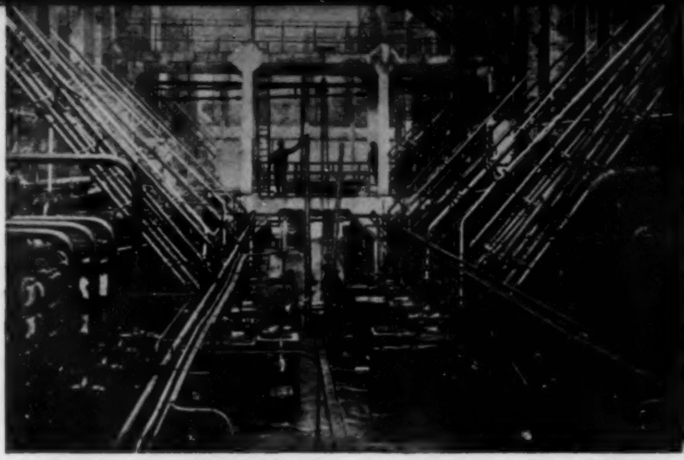
Part II.

An Outline of the Production of Explosives in the United States, 1939

THE UNITED STATES OF AMERICA is in a better position than any other country in the world in regard to the huge wealth of its raw materials, the chemical organization for the production of large quantities of explosives, and transportation facilities.

Uncle Sam's enormous resources in natural gas, in crude oil, and in partly aromatic bituminous coals give this country a great advantage over other countries of the world; her wealth in carbohydrates, such as cellulose (cotton linters, wood pulp and starch) and various sugars—also her large production of fats—allows the production of important raw materials for the explosives industry in practically unlimited quantities. Those materials which are scarce in the United States can certainly be procured from other American countries—Canada, Bolivia, Argentina, Brazil, Mexico, Peru, Guatemala. For example, nickel and aluminum from Canada, antimony from Bolivia and Mexico, bauxite from British Guiana, chromite from Guatemala, graphite from Mexico, manganese from Argentina, Brazil, Chile, Cuba, and Mexico, mercury from Bolivia, Chile, and Mexico, nitrates from Chile, platinum from Canada and Colombia, tin from Bolivia, and vanadium from Peru.

Part I of this article described the situation of the Central Powers during the last World War. In this brief section the progress made since that time and the different situation due to the United States' raw material position for explosives manufacture will be considered. It is impossible to mention here all the many explosives which have special uses and are produced in relatively small quantities. Only those explosives will be considered which can be produced in large quantities because of the large supplies of raw materials at the disposition of this country and, further-



Conversion of ammonia into nitric oxides was accomplished in a huge absorption plant designed by the author. Cooling at the rate of more than 30,000,000 B.t.u. per hour was required here

Accidents did occur, though seldom. In this one 4,000 lb. of picric acid exploded killing 35 men. No trace was found of the five men in the crystallizing room

more, which can be produced by rather simple and inexpensive methods.

To present the explosives situation in the clearest and most concise form, the author has adopted an outline presentation based on the raw material used.

A. Natural Gas—

1. Methane can be converted by steam and/or oxygen (air) into a mixture of carbon monoxide and hydrogen, which is in turn converted by high pressure and catalysis into methanol. Formaldehyde can be obtained by direct oxidation of CH_4 or from methanol at ordinary pressures.

2. Direct nitration of CH_4 results in the formation of mononitromethane, NO_2CH_3.

3. Combination of Items 1 and 2 above allows the production of nitroisobutyl-glycerine, $O_2N\text{-}C(CH_2OH)_3$. This upon nitration yields nitroisobutyl-glycerine-trinitrate, $O_2NC(CH_2\text{-}ONO_2)_3$, which has the same chemical and ballistic properties as glycerine trinitrate.

4a. Methane may be converted into acetylene at about 1,200 deg. C. ($2CH_4 \rightarrow C_2H_2 + 3H_2$).

4b. Acetylene can be converted (at about 700 deg. C. with excellent yields) into aromatic hydrocarbons (benzene and homologues) which upon nitration form valuable aromatic nitro compounds.

4c. Acetylene can be easily converted into acetaldehyde (CH_3CHO) and acetic acid. This by catalytic or other processes is made into acetic anhydride.

4d. Acetaldehyde and formaldehyde (from *A*-1) form pentaerythrite, $C(CH_2OH)_4$, which upon nitration forms pentaerythrite-tetranitrate, $C(CH_2ONO_2)_4$, one of the most important newer explosives.

4e. Acetic anhydride (from *A*-4) and nitric acid form tetranitromethane, $C(NO_2)_4$, which with additional material such as toluene or nitro aromatics forms most powerful explosives.

5. By incomplete combustion lamp black and other forms of carbon result. They are important for liquid air (oxygen) explosives.

B. Crude Oil—

1a. Broad use of oil as crude or of certain fractions of it is important for all kinds of vehicles—for planes, cars and ships. This and the fact that it allows a smokeless combustion will not be considered here.

1b. Certain crudes contain interesting amounts of aromatics. These can be extracted with modern extraction processes, for instance with liquid SO_2 or phenol compounds, or other substances with partial valences. These extracted aromatics after purification and fractionation can be nitrated and form excellent nitro compounds, such as TNT.

1c. Through cracking of these crudes, aliphatic unsaturated hydrocarbons result. At higher temperatures aromatic hydrocarbons result. (See *B*-5).

2a. Cracking gases contain ethylene in large quantities, which can be separated in many different ways—either chemically or physically—from other saturated and unsaturated low boiling hydrocarbons. Ethylene allows the cheap production of (1) ethyl alcohol, which is a very important solvent and recrystallizing medium for all kinds of explosives; (2) acetaldehyde, acetic acid, and acetic anhydride in unlimited quantities (see also *A*-4); (3) ethylene oxide by direct oxidation with or without catalysts.

Ethylene oxide forms ethylene glycol which also is produced from ethylene with HOCl. Ethylene glycol is a very important raw material for explosives. Nitrated together with higher poly alcohols (glycerine, for example) it forms excellent low freezing mixtures of organic nitrates which are important for smokeless powders and for all kinds of dynamites. Glycol is also an important raw material for the production of yperite (mustard gas).

2b. Propylene in cracking gases is the raw material for the production of (1) acetone, which is the universal solvent for all kinds of explosives and plays an important role in gas war as well (Ketene can be produced from acetone as well as from acetic acid, see *B—2a*-2); (2) glycerine, which is a very important recent development because it allows the production of unlimited amounts of glycerine for glycerinetrinitrate (smokeless powders, dynamites). Glycerine prices in former wars, through the scarcity of fats, went very high. (In the last war the Central Powers never produced enough dynamite glycerine). Now through the cheap and unlimited production of glycerine and glycol from cracking gases, this scarcity of aliphatic polyalcohols certainly can be avoided.

2c. Butane in cracking gases can be converted by dehydrogenation into (1) butylene which can be converted into butanol and butanol acetate; (2) butadiene from which artificial rubber can be produced.

3. From the production of certain pure oil compounds such as white oil, worthless acid sludges results. Now these sludges can be converted into activated carbon which is used for the adsorption of poisonous gases and for the purification of bacteria-poisoned water. It can be used also as an important component of certain dynamites and for liquid air (oxygen) explosives (see *A*-5).

4a. Through the dehydrogenation and condensation of cracking gases, valuable aromatics are obtained, which, like benzene and toluene, are the basis for important aromatic nitro compounds.

4b. By the catalytic oxidation of

aromatic hydrocarbons or their transformation over sulphonic acids or chloro compounds such as monochlorbenzene, phenols are obtained. By their nitration nitrophenols result, which are of outstanding military importance. Trinitrophenol (picric acid) is about 1/7 more powerful than TNT. Ammonium picrate made from picric acid also has certain advantages. For the plastics industry large amounts of synthetic phenols, besides the "natural" phenols, are produced in this country.

5. Aromatics can also be obtained by the cracking of liquid aliphatic hydrocarbons, mostly in the gas phase, at temperatures above 550 deg. C. By extraction processes and by fractional distillation in the much improved bubble cap towers or packed towers, C.P. hydrocarbons such as toluene are produced with a high degree of purity; so their subsequent nitration does not present any technological difficulties.

C. Fermentation—

1. By fermentation, alcohol is formed from carbohydrate—containing material such as molasses or potatoes, etc. Production of acetone, butanol and other solvents important to the explosives industry is likewise done by fermentation.

2. Glycerine is produced from sucrose by fermentation in the presence of sulphites.

D. Sugars—

Through the electrochemical reduction of simple sugars such as mannite and sorbite, those aldehydic compounds are converted into the corresponding alcohols, mannitol and sorbitol. These interesting poly-alcohols furnish upon nitration the corresponding higher melting hexanitrates which replace fulminates and azides in detonators.

E. Bituminous Coals—

1. It has been known for a long time that by destructive distillation at about 1,000 deg. C. bituminous coals yield secondary (aromatic) tar. This tar contains rather large amounts of aromatic hydrocarbons which are also present in the resultant coke oven gas. With wash-oil absorption or activated carbon adsorption a mixture of aromatic hydrocarbons results. From it by distillation and chemical purified C.P. aromatic hydrocarbons are obtained which can be nitrated easily. Phenol compounds are also formed directly by these destructive distillations or can be made from aromatic hydrocarbons according to *B*-4-*b* above.

2. Extraction of the bitumen directly from bituminous coal with appropriate solvents at normal or higher pressures and temperatures may become important. These bitumens contain large amounts of phenols and phenol carbonic acids, as well as neutral—partly aliphatic, partly aromatic—hydrocarbons, which can be used as raw materials for explosives.

3. Upon hydrogenation of the coals and of secondary tar, oxygen-free hydrocarbons of partly aliphatic, partly aromatic character, with or without aliphatic side chains, result. These also have a certain amount of importance as raw materials for the explosives industry.

4. Primary tar resulting at about 500 deg. C. contains large amounts of phenols which can be easily extracted either with alkali or with overheated liquid water under pressure. These phenols may be used as important raw materials.

5. Coke oven gas resulting from this destructive distillation contains, in addition to more than 50 per cent of hydrogen, valuable hydrocarbons such as methane (see *A* above) ethylene (see *B*-2*a*), propylene (see *B*-2b) and carbon monoxide. This coke oven gas is used successfully for the synthesis of ammonia and nitric acid, also for the production of liquefied hydrocarbons (for example liquid CH_4 as an anti-knock motor fuel) and of methanol, higher alcohols, aldehydes, ketones, and acids.

6. From the distillation of bituminous coals at high temperature (1,000 deg. C. and higher) about 25 per cent of the nitrogen present in the form of unknown compounds in the coal is transformed into ammonia, cyan and thiocyanide compounds. Ammonia can be converted easily into nitric acid which is the basis of most explosives.

F. Sulphur

The tremendous wealth of this country in sulphur and in pyrites and other sulphides such as zinc blends and copper ores, allows the cheap production of unlimited quantities of sulphuric acid and oleum, which are of fundamental importance for the production of explosives.

1. The pressure synthesis of H_2SO_4 from roast gases with the nitric oxide process may obtain importance in the future.

2. The recovery and use of sulphur and sulphur compounds from these products of high temperature distillation of bituminous coals (see *E*-1) is less important in the United States than in countries with small sulphur deposits.

G. Electrochemicals—

The highly developed electrochemical industry of this country, based on very cheap electric energy, can produce chlorine and chlorine compounds such as chlorates and perchlorates for chlorate and perchlorate explosives in practically unlimited quantities.

H. Safety—

The development of chemical engineering in the last twenty years has made possible the carrying out of many of those rather dangerous processes for the production of explosives with much more safety. Very often discontinuous operations with large batches can be replaced by continuous operations with smaller quantities in a given piece of apparatus at a given time. The high pressure technique developed shortly before the outbreak of the first great war allows the carrying out of hydrogenation processes (for instance, hydrogenation of nitrogen, carbon monoxide, and coals) on a larger scale (See *A*-1, *E*-3, *F*). The combustion of ammonia and the transformation of nitric oxides under pressure with air and water into concentrated nitric acid has given excellent results. The process of nitration of cellulosic material and the stabilization of resulting cellulose nitrates can now be carried out continuously. The nitration of wood pulp in the form of thick sheets with the formation of uniformly nitrated material has been made possible. Nitration of glycerine and mixtures of glycerine with glycol, also the nitration of aromatic hydrocarbons, such as toluene, can also be carried out continuously, thereby reducing the danger of such operations. The introduction of valuable construction materials such as stainless steel and pure aluminum has simplified many operations involved in the making of explosives.

This superficial study shows the great superiority of the United States in the production of explosives for war and for peace purposes. A similar consideration could be made concerning the production of poisonous gases, which, according to an agreement between the nations now at war, will perhaps not be used in the so-called Second World War.

What Germany Wants in Poland

Dr. Falk reviews here the raw materials and chemical industry which may make Poland a valuable acquisition to the German Reich. He knows whereof he speaks for he was employed by the Upper Silesian Steel Corp. in 1936 and 1937 and by the German Institute for Business Cycle Research in 1934 and 1935.

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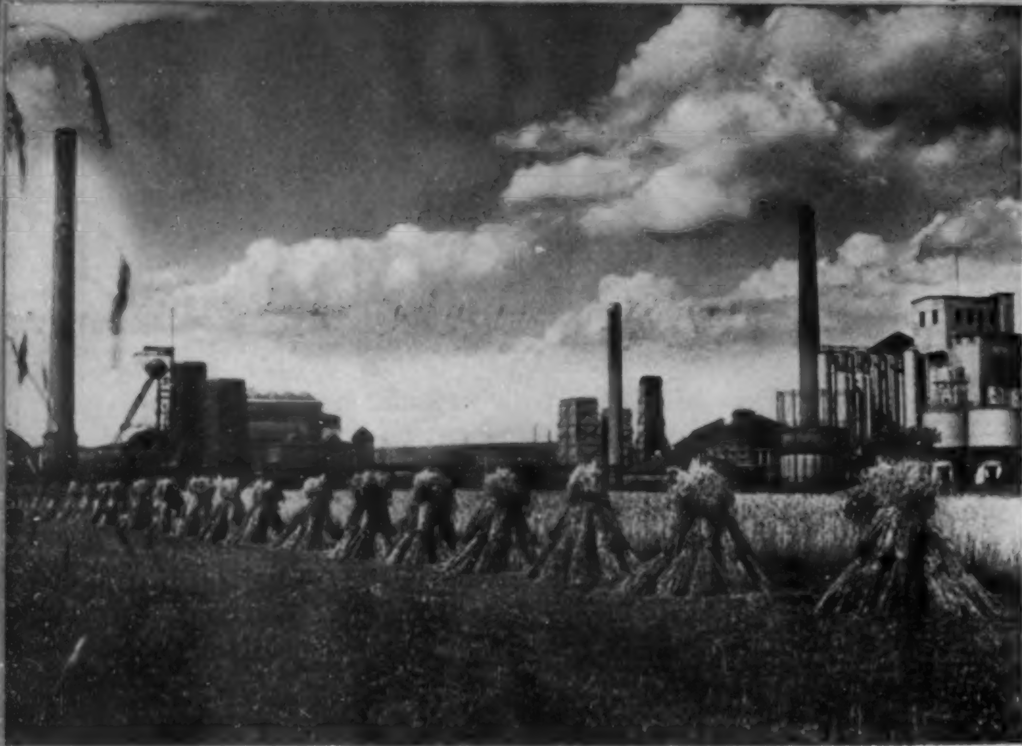
PINCHING OFF the Polish Upper Silesian industrial area without destroying the factories and mines was one of the long-planned objectives of the German army marching into the south of Poland in September. This area, conceded by the Reich at the close of the World War—about one-fourth as large as the Ruhr and one-third as large as the Calumet district at Chicago—is roughly 25 miles long and 10 miles wide. It extends in the west from Gleiwitz in German Upper Silesia across the Polish Upper Silesia into the Dombrowa district of former Russian Poland. Its industries are built around valuable coal and zinc deposits located at the borders of Germany, Poland, and former Czechoslovakia.

Before Poland acquired Teschen, or Olza Silesia from partitioned Czechoslovakia a year ago, Polish Upper Silesia supplied 75 per cent of Poland's total coal, iron, and steel production, 90 per cent of its zinc, 95 per cent of its lead, 85 per cent of its sulphuric acid, and 45 per cent of its nitrates. Poland's leading state chemical plant at Chorzow was situated in the Upper Silesian area only five miles from the German border. According to U. S. consular reports, two years ago 90 per cent of Poland's armament industries were located in the frontier areas of Polish Upper Silesia, although in the meantime the Republic made strenuous efforts to shift as much of this as possible to the large new Sandomierz industrial triangle in the interior, located roughly between Cracow, Lublin and Lwow. Nevertheless, up to the outbreak of the war, the bulk of Poland's industrial export trade still originated in Upper Silesia, going up the "Corridor" from Katowice on the rail "coal magistrale" to Gydnia, Poland's new seaport whose turnover in 1938 was valued at three times that of Danzig.

The latter so-called "safety industrial triangle" around Sandomierz proved one of the next of the Reich's military objectives, and with Warsaw and Lodz being the only important manufacturing cities outside the two triangles, Poland's industries were thus almost completely in German hands a few weeks after the war's outbreak. The Sandomierz project known better in Poland as "C.O.P." (Centralny Okreg Przemyslowy), (whose industrial area proper is smaller

On August 31, 1939, before Hitler's troops marched into Poland, the map of the Republic looked like this. Polish chemical industry and raw materials, in the areas spotted on the map, will add materially to those of the Reich



Agriculture and industry live side by side in the rich area of Upper Silesia as evidenced by this German coal mine and processing plant in the midst of a grain field on the Polish border

than that outlined on the map) extends between the tributary Pilica, the river Bug, the Beskid mountains, and the Vistula river, was ambitiously conceived and developed by the Polish government with the aid of military experts during the past few years. Only partly completed when taken over by the Reich forces, it already had in operation a number of important plants for the manufacture of airplanes, munitions and chemicals. The project called for utilizing overland power developed in government hydroelectric plants in the mountains and natural gas wells in the south and was to be based on petroleum, salt and metal deposits in this area. Chemical raw materials, including potassium and magnesium salts, phosphates and pyrites were exploited chiefly by the Polish government.

Although Poland had available a number of important raw materials for the chemical industry such as coal, lignites, wood, petroleum, sulphur, pyrites, phosphorites and salts, in the past they were produced in insufficient quantities and had to be supplemented by imports. Poland could supply her own requirements of salt and potash, while pyrites and a low grade sulphur were being mined in increasing quantities. Phosphorite deposits in the Dnjester basin in Podolia may be developed in the future, as also some gypsum, quartz, basalt and kaolin deposits found elsewhere in Poland. Geological investigations recently indicated the presence of magnesite and manganese and other ores around Kielce, which is also within the large Sandomierz triangle. That these raw materials have not been developed more fully in the past has been due to lack of capital, limited domestic consumption, and inability to compete in world markets without heavy government subsidy. Lack of adequate transportation facilities has severely handicapped the development of these raw materials as well as the new "C.O.P." industrial area. Whether Germany will attempt the immediate exploitation and further development of these industries remains a question as long as the ultimate political fate of the region is in doubt.

Simultaneously with the attempt to develop the central "C.O.P." triangle, many factories operating in other parts of Poland have been establishing branches there. By July of this year, for example, the new branch plants ready for operation increased the production capacity of the parent chemical companies, chiefly Boruta, Lignoza, Stomil, and the Polish Coke Union, by about 50 per cent. Import and currency restrictions and the drive toward national defense self-sufficiency were responsible for the establishment of a number of new chemical plants during the past few years. Another development was that foreign companies, Belgian, French and Swiss, no longer able to export, set up subsidiaries in Poland. Germany's I. G. Farben, however, decided after a careful study in 1936 of future market possibilities not to try to expand activities in Poland since it was concluded that the domestic plants could supply heavy chemicals, and the market for fine chemicals seemed limited. Changed political circumstances may see a reversal in policy now, however, and it is conceivable that I. G. may buy out some of the foreign and domestic holdings in this area.

In spite of the autarchic tendencies, imports, especially of fine chemicals rose by 10 per cent to $14,221,000 in 1938, while Polish exports (chiefly to Baltic countries, some to Brazil and Far East) declined to $6,122,000 in 1938. Domestic production on the whole, however, reached a new high level. Recently the Polish government encouraged the production of fine chemicals in addition to crude chemicals, and whereas up until a few years ago 90 per cent of fine chemicals used in Poland were imported from Germany, in 1936 only 70 per cent of total imports came from there, and the ratio declined still further in the meantime as domestic production increased. In the past, Germany, Switzerland, France, Great Britain, Belgium, and the United States, in that order, have been the principal suppliers of Polish chemical raw materials and fine chemicals, carbon black, essential oils, pharmaceuticals, dyes, tannings, and resins. Although foreign exchange difficulties caused a shift in Poland's import trade in 1938 from free currency markets to clearing countries, the United States increased her chemical trade with Poland last year over 1937 in spite of the fact that she could not always obtain the necessary import permits.

The chemical industry in Poland in areas which Germany has taken over, chiefly in the two industrial triangles mentioned, comprises over 300 large and middle sized plants employing over 50,000 workers. The majority have been organized in the 20-year old Chemical Association of Poland, closely collaborating with the government.

The Chorzow plant in Upper Silesia, built by Germany toward the close of the war and ceded to Poland with the area, and the Moscice plant (named after the President of Poland, Ignacz Moscicki, professor of chemistry) in the "C.O.P." triangle are both government owned. Merged in 1933, they are today the principal manufacturers of chemicals, chiefly nitrates, artificial fertilizers, cyanamide, and nitric acid. Following in importance are the Tomaszow Rayon factory, producing also Glauber's salts, anhydrous and

calcined sodium sulphates; Solvay, producing sodium compounds; and Schicht, Lever Bros., vegetable oils and fats; Giesche S.A. of Katowice, American Anaconda controlled, has recently undertaken the production of red lead and litharge in addition to its zinc and coal operations. The Olza Silesian areas from Czechoslovakia added considerably to the coal tar products industry with five coke plants; the Larish plant, manufacturing fertilizers, especially superphosphates, acids, and other products; and the Zaklady Chemiczne S.A. in Bohumin manufacturing saccharin, glycero-phosphates, pharmaceuticals, insecticides, zinc white, and chemically pure salts; besides a number of small factories for cosmetics, toilet soaps and fats. Germany is now taking over all these plants to augment the increase already caused by the incorporation of the industries of Austria and Sudeten Germany. In the Sudeten area the principal items produced are heavy chemicals, fertilizers, coal tar dyes, explosives, pharmaceuticals, glues, and insecticides, while wood distillation, wood sugarization and staple fiber production are of importance in the Austrian district.

Excepting for the larger industrial plants, the chief advantage to Germany in acquiring this Polish territory may prove to be the raw materials, which as yet are relatively undeveloped. The exploitation of these resources — assuming Germany retains control of the area for a longer period—would, of course, take time. This would still leave German industry with its basic raw material problem. Although great progress has been made in the development of synthetics, Germany is still vulnerable if cut off from supplies in foodstuffs, oil and metals.

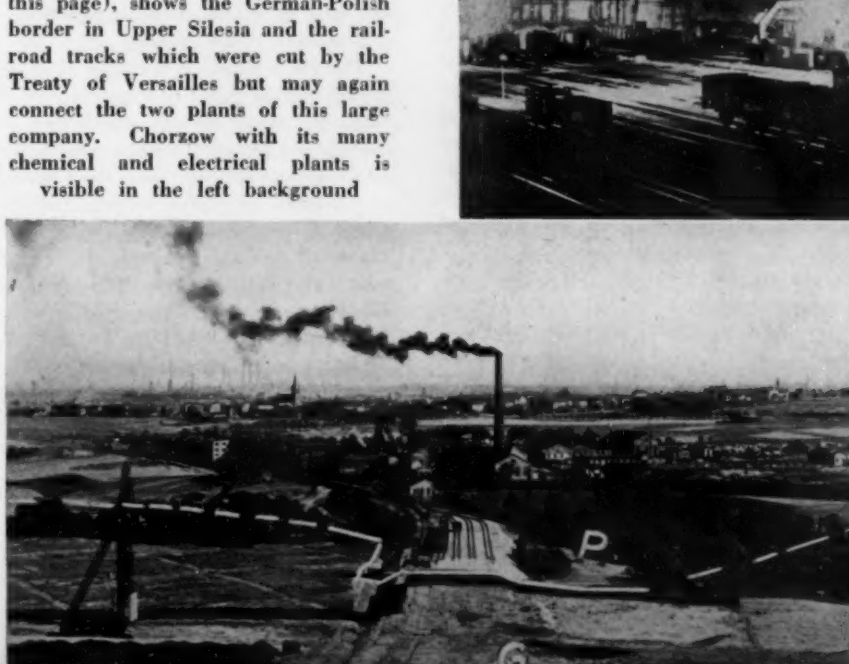
During the past two years domestic iron ore production in Germany has increased by two-thirds, but this represented only 15 per cent of her iron ore requirements last year. About 65 to 70 per cent of the ores had to be imported, and the remainder had to be obtained from scrap iron. Last year Sweden supplied 41 per cent of the Reich's iron ore and apparently will continue to ship from the Lulea mines in the northwest, high grade phosphoric ores which are mixed with low grade domestic ores in the Thomas process in the Reich. Germany can now completely cover her domestic zinc requirements, especially since she again controls the eastern Upper Silesian fields adjacent to her western fields near Beuthen. Bauxite for aluminum production can continue for the time being to be supplied from the Balkan area. Copper will present more difficulties. Although the lower grade domestic Mansfelder and other copper deposits are being vigorously exploited, considerable imports will still be required. The acquisition of copper, for instance, from Jugoslavia presents the same difficulties as oil from Rumania. In both cases a considerable part of exportable surpluses in the past have been earmarked for other countries, partly to obtain necessary free foreign exchange, and partly because British, French and American capital control producing companies and have preferred to sell elsewhere. Under military and economic pressure, however, these countries can probably be made to deliver larger quantities of mineral oil, bauxite, copper, timber, live stock and grain to Germany.

Although Germany's trade with the five Balkan countries, Jugoslavia, Hungary, Bulgaria, Rumania and Greece has almost quadrupled since 1932 — chemicals represent 10 to 15 per cent of the total trade — so that she now shares in from 30 to 60 per cent of both imports and exports of these countries, they supplied only 5.8 per cent of her industrial raw materials and semi-manufactures last year. Thus Southeastern Europe has been, heretofore, of relatively little importance as a cource of supply for Germany's raw materials, even though the Reich did acquire 22 per cent of her entire food imports there in 1938. Important primary raw materials such as cotton, wool, iron ore and rubber are practically unobtainable from these regions. The Reich will therefore have to look to other parts of Europe or to other neutrals for these materials.

The more neutrals remaining in Europe (Germany still retains contact with areas from which she obtained 44.7 per cent of her imports the first quarter of this year.) the more favorable will be her strategic position. Probably the Reich will not continue to maintain the volume of peace time trade with all the neutrals (In the last war Sweden was the only non-belligerent whose exports to Germany during the war exceeded the 1913 level.) especially since Great Britain will make every effort to prevent supplies from reaching her.

At one of the largest and most modern coal mines in Europe, this tipple is located only 100 yards from the Polish border. Now the plant may again be connected to its holdings on the other side

This photo, taken from the tipple of the Hohenzollern mine (pictured on this page), shows the German-Polish border in Upper Silesia and the railroad tracks which were cut by the Treaty of Versailles but may again connect the two plants of this large company. Chorzow with its many chemical and electrical plants is visible in the left background



Sulphite Liquor Developments

Not only has the stream pollution problem been very materially reduced but many profitable products have been recovered from the waste sulphite liquors by the chemical engineers of the Marathon Paper Mills Co.

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The Marathon Paper Mills Co. has been engaged for many years on pioneering research and commercial developments in the disposal and utilization of waste sulphite liquor containing the lignin and hemi-cellulose constituents of the wood dissolved in the pulping process. The objectives of this investigation have been first to reduce the stream pollution incident to the discharge of this liquor into waterways and second to supplement the value of the cellulose pulp by realizing on the commercial potentialities of the large tonnage of non-cellulose organic matter going to waste in such liquor.

The work has resulted in the development of the Marathon-Howard Processes. Waste sulphite liquor is now being treated on a commercial scale by these processes at the Rothschild, Wis., mill resulting in a reduction in stream pollution and the manufacture of a variety of products for use by the pulp mill and for sale.

The main process by which the liquor is processed into primary products is a three-stage lime precipitation treatment. The waste liquor as it drains from the blow pits in the pulp mill is pumped over an inclined screen to recover fiber carried through the drainer bottom and then collected in raw liquor storage tanks where the strong and dilute liquors equalize to give a feed of uniform concentration. Sufficient liquor can be collected to carry over 90 per cent of the total organic matter dissolved from the wood in the pulping process. The processing of this high percentage of the total organic matter is made possible since the process does not involve evaporation. Hence both the strong and dilute blow pit drainage can be economically handled.

From the storage tank the hot liquor is pumped at a uniform rate to the first reaction tank in which a caustic lime reagent is added. The amount of the chemical is varied in order to precipitate an inorganic product which is essentially calcium sulphite. This precipitate is settled and pumped as a slurry to the pulp mill for use in making fresh cooking acid.

The remaining clear liquor flows to the second reaction tank in which it is again treated with a controlled amount of the lime reagent in order to precipitate an organic product. This precipitate is settled and removed as a wet cake on a rotary vacuum filter. It is essentially a basic calcium salt of lignin sulphonic acid and constitutes the organic product, recovered by the process for use as a lignin raw material or as a boiler fuel.

The liquor remaining from this second precipitation and settling passes to a third reaction tank in which it is given a stripping treatment with an excess of lime reagent. This precipitates some additional lignin material which is settled out together with the unconsumed lime reagent and returned as a slurry for use in the process as the lime reagent added in the first reaction tank to precipitate the incoming raw liquor.

The clear liquor remaining after removal of this third precipitate constitutes the main effluent which can be discharged into waterways with materially less polluting effect than would result from untreated liquor. This effluent is hot and alkaline with lime. Its heat content can be utilized to heat wash waters before discharging it into the sewer. Or if desired this effluent can be processed further for the recovery of additional products. (For more detailed description and discussion of main precipitation process see *Paper Trade Jour.*, July 2, 1936.)

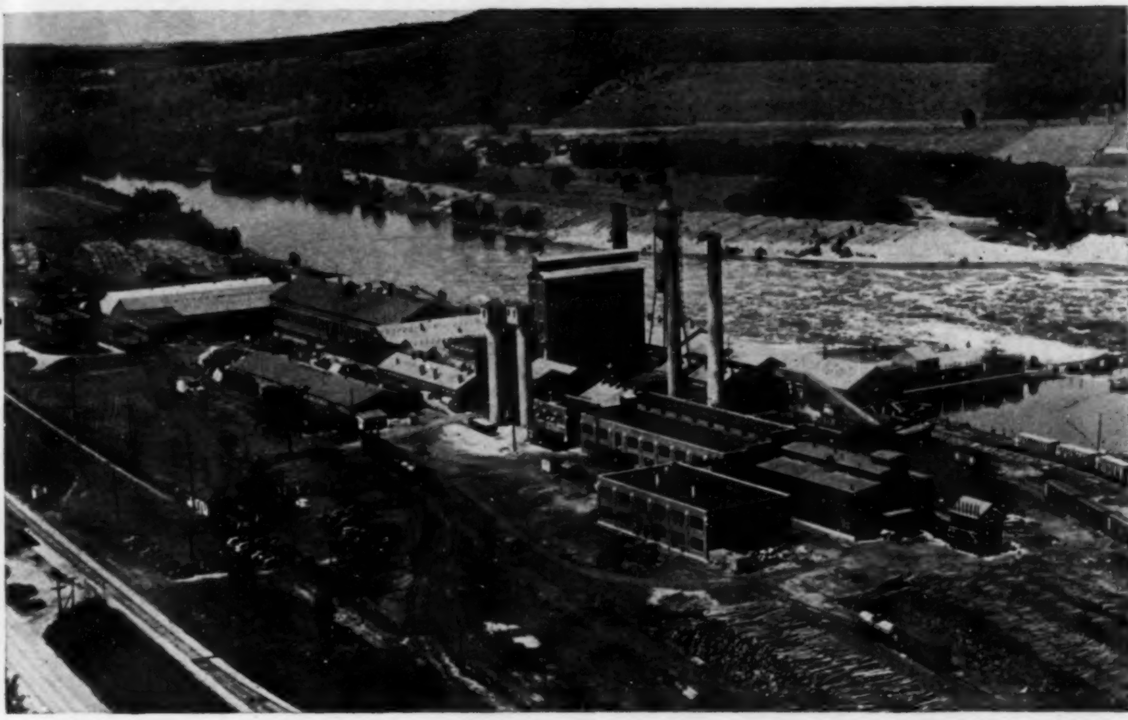
Plant operations on a commercial scale by Marathon have demonstrated it is entirely practical to collect and process waste sulphite liquor by this three-stage lime precipitation treatment and have either fully confirmed original estimates as regards yield, character of products and operating expenses or have demonstrated with reasonable certainty that they are attainable with improvements in operation.

The yield of the inorganic product has been fully up to expectations and its calcium sulphite content is being successfully utilized by the pulp mill for making fresh cooking acid with a corresponding reduction in other lime and sulphur requirements and without complications in the pulp mill.

The yield of the organic product has not been fully up to preliminary estimates due to unforeseen secondary reactions which have resulted not only in a lower recovery of the organic product but some increase in lime reagent requirements. The remedy for this adverse operating condition is now known, however, and the necessary alterations to correct it are being made, with some indications of their resulting in an even higher yield of this product than originally estimated.

The organic product is being used as a lignin raw material for the manufacture of various special products referred to later and as a boiler fuel. It is recovered as a wet filter cake containing around 70 per cent moisture and requires a reduction in its water content before it can be used as a boiler fuel. This is accomplished by mechanically pressing the filter cake in a tractor type press designed by Marathon and built under the Thompson patents. It yields a pressed cake containing around 50 per cent moisture which has been successfully burned over long periods with admixture of 10 per cent coal screenings in

Based on paper presented before American Pulp and Paper Mills Superintendents' Association, Wausau, Wis., Sept 9, 1939.



The four rectangular buildings in the right foreground are the Chemical Products Division of Marathon Paper Mills Co. for processing sulphite liquors

a standard water tube boiler equipped with Firite stoker, and with an overall heat efficiency around 70 per cent for this wet fuel.

Laboratory tests by Marathon and others on the main process effluent in comparison with the untreated liquor show a reduction of around 80 per cent in the biological oxygen demand (B.O.D.) thus indicating a very material improvement in favor of this process effluent as regards stream pollution.

As a disposal method for reduction of stream pollution only the processing plant can be simplified and made to cost less than the present installation at Marathon. It is believed that this lime precipitation process offers the most economical method available for processing sulphite liquor to reduce its pollution characteristics and for most pulp mill conditions it should be sufficient to avoid stream pollution. If it is necessary in special cases to further purify the effluent it can be done either by yeast fermentation of the raw liquor prior to the lime precipitation or by biological treatment in a trickling filter of the effluent from the lime precipitation or by giving this effluent a brief pressure cook to precipitate additional organic matter.

The most fundamental accomplishment of this work at Marathon is the segregation of the major components of sulphite liquor thereby facilitating its more complete utilization and making available for the first time a large tonnage of lignin as a new organic raw material at low cost and in most favorable form for commercial uses.

The basic calcium lignin sulphonate recovered as the organic product, constitutes such a lignin raw material. It is comparable with coal with respect to its chemical potentialities and has already found various uses both with and without further processing. It lends itself to processing by the procedures of organic synthesis and to inorganic modifications.

The organic product without further processing, other than drying and grinding, is now being used in carload quantities for various purposes and other tonnage uses are in prospect.

More than one-third of the vanillin manufactured in the United States is now being made from this lignin raw material. Its excellent quality has been fully established.

The spent effluent liquor from the vanillin operation is being processed further to make lignin plastic products, which it is expected will ultimately include lignin core and surface sheets for laminating, lignin molding compositions for positive, injection and impact molding, and special lignin resins for coating, impregnating and adhesives. Of these the lignin laminating sheets are in commercial production, and the molding compositions and special resins are in semicommercial production.

The basic calcium lignin sulphonate, i.e., the organic product, can be converted by inorganic modifications into a complete series of lignin sulphonate salts and into the free lignin sulphonic acid. Of these the magnesium, calcium and sodium salts are now being made and sold in tonnage quantities for use in tanning leather, in treating boiler waters, in products going into cement, as dispersing agents, grinding aids, and for various other uses.

These patented processes are available to the sulphite industry as a disposal method of handling sulphite liquor to reduce stream pollution, but with the use of recovered products restricted to the pulp mill for making fresh cooking acid and as a boiler fuel. However, as a combined disposal and utilization method of handling sulphite liquor with the manufacture of products for sale it is necessary to keep the production of such products in line with their market outlets and hence, for the present at least, patent rights to make and sell special lignin products can not be made available to other pulp mills.

Thin 18-8 for Process Equipment

Developed originally for the fabrication of thin stainless steel for rail cars and airplanes, the Budd "Shotweld" process has recently been applied to the production of light-weight, high-strength stainless steel process equipment which requires no heat treatment to avert the possibility of intergranular corrosive attack.

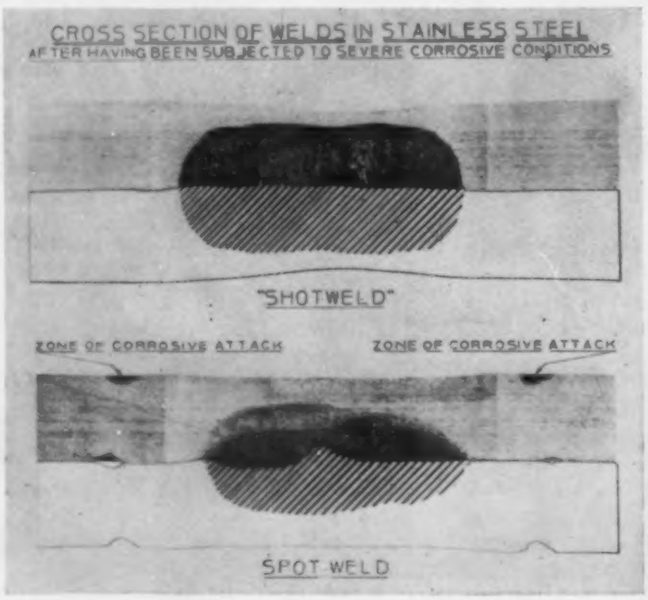
EDITORIAL STAFF

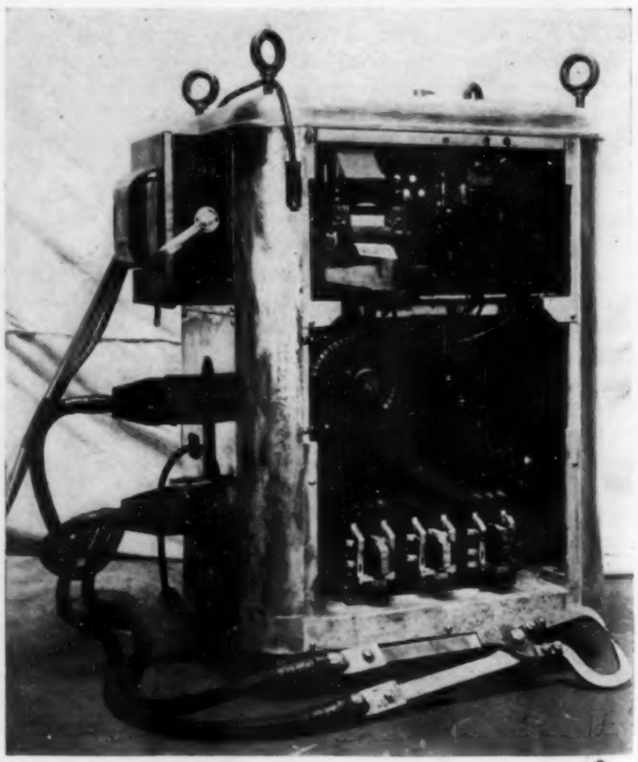
Mention stainless steel and most chemical engineers immediately think of the high corrosion resistance of this series of chromium-nickel-iron alloys. This is not surprising since it is largely for their corrosion resistance that they have been used in process industries. In the past three or four years, however, much of the stainless steel that has been produced has been used for quite another reason: exceptionally high strength, which has meant the possibility of important weight savings in structures for transportation on land, in the air and at sea. With the development of methods for economical fabrication of thin 18-8 stainless steels, the now well known practice of using such materials for airplane and stream-lined rail car construction came quickly into being. In recent months similar methods have been employed in fabricating an increasing variety of process plant equipment where light weight, high strength and corrosion resistance have been concomitant requirements.

At the risk of retelling a story which is already at least partially familiar to the many people who have seen the stainless steel rail cars now operating in such large numbers on American railroads, it is desirable to go back a few years to the inception of the idea of using stainless alloys primarily for high strength. Ordinary grades of steel having a tensile strength of, say, 55,000 lb. per sq.in. have been used for years, and in tremendous quantities, in transportation equipment. Little concern was felt for their weight until the stage of rapid development in heavier-than-air transport was reached, when extensive search was instituted for materials that were both light and strong. Here 18-8 stainless suddenly became

Right—Budd "Shotweld" machine showing controls, record tape and tongs-type electrodes

Below—Photomicrographs of weld specimens after immersion in hot HCl, showing no corrosion in "Shotweld" specimen, with annular corrosion around the spot weld





attractive, for this material, although it is no lighter than ordinary steel, is so much stronger that it can be used in much thinner sections. Furthermore, it requires no allowance for atmospheric corrosion and needs no protective coatings. Even in the annealed condition, 18-8 stainless has a tensile strength of 85,000 lb. or more per sq.in. Although heat treating will not increase this strength, cold working will, and strengths as high as 250,000 lb. per sq.in. can easily be attained in that way.

If stainless was to attain extensive use in transportation equipment, however, there was no doubt that better fabrication methods would be needed. Welding, the logical method, had the disadvantage of paving the way to intergranular corrosion unless specially protected steels were employed, or unless the welded structure were later heat-treated at an elevated temperature. Riveting, a possible procedure with thicker metals, would be hopelessly expensive in making the enormous number of connections required in many sorts of structures built up of thin metal.

The problem of welding ordinary 18-8 stainless in thin sections without producing the condition which leads to intergranular corrosion was solved by the invention of the "Shotweld*" process by Col. E. J. W. Ragsdale, of the Edward G. Budd Mfg. Co., Philadelphia. This process and the equipment invented to carry it out†, so facilitated the use of thin stainless for high strength structures that the Budd company was able immediately to make striking advances in transportation equipment, particularly in airplane wing and fuselage design and in light-weight rail cars. Numerous other applications quickly followed as a logical development, including many types of processing equipment such as centrifugal baskets, materials handling containers, ducts, fume hoods, lids, kettles, tanks in wide variety, and rayon machinery.

A better conception of what this process accomplishes can be attained if we recall the action of ordinary 18-8 stainless during welding. This material is an austenitic steel, with carbon of less than 0.15 per cent, the carbon being in solid solution. As long as the carbon remains in solution, a high degree of resistance is retained against most important corrosive agents. However, when 18-8 steel is heated to its fusion temperature of about 2,600 deg. F., areas near the weld ordinarily attain and for a time hold temperatures within the carbide precipitation range of 1,100–1,600 deg. F. At these temperatures chromium carbide is formed, precipitating along the grain boundaries and slip planes and leading to the possibility of the kind of embrittlement and disintegration known as intergranular corrosion.

Operator welding thin 18-8 steel for a strong, light-weight structure

This action is what occurs in ordinary spot welding of 18-8 steel, the characteristic result being to produce an annular zone a short distance from the weld which is no longer resistant to corrosion.

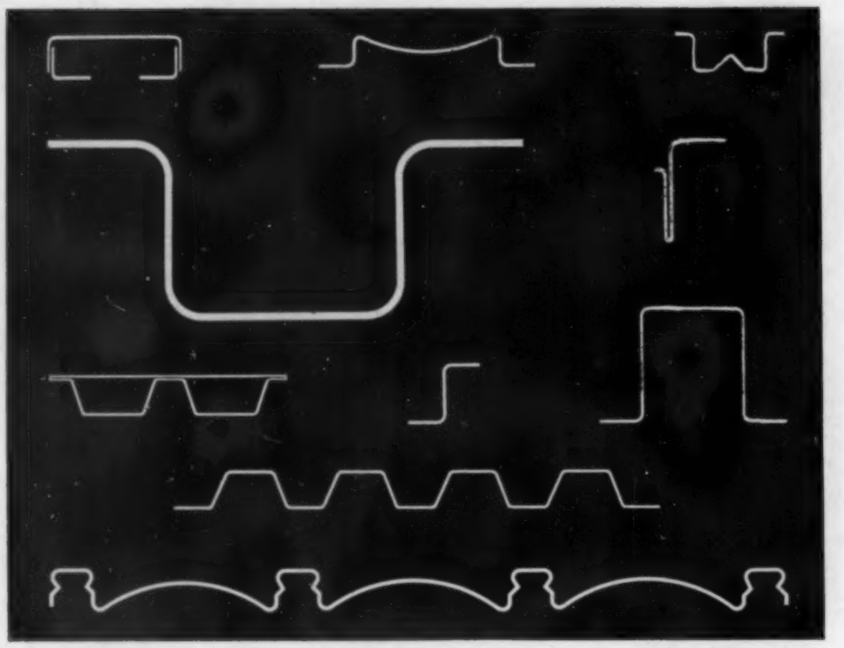
It is true that the damaged area can be repaired by heat treatment which will cause the re-solution of the carbon, but this treatment is difficult and expensive and would be practically impossible with many large structures. Furthermore, the extremely high tensile strength that can be produced by cold working is thus lost and the steel reduced to its original annealed condition.

Another expedient is to use a "stabilized" 18-8 steel, that is, one containing a small percentage of certain metals such as titanium or columbium. Such alloys do not suffer from carbide precipitation, but they are considerably more costly than ordinary 18-8 steels, as much as 35–40 per cent higher in certain forms, and have certain other disadvantages as well.

Two apparently adverse properties of ordinary 18-8 steel, namely low thermal and electrical conductivity, furnished the clue which led to Col. Ragsdale's invention. With the high resistance of the metal, sufficient heat for fusion could easily be obtained by passage of a heavy electric current; and with the low thermal conductivity, this heat could easily be localized. In resistance welding the heat produced by the passage of a current is I^2Rt, where I is the current, R the resistance, and t the time. If t could be kept sufficiently small—a fraction

* Trade mark registered, U. S. Patent Office.

† See for example U. S. Patents 1,944,106 and 1,938,499.



Sketches illustrating typical cross sections employed to give high strength to thin-gage stainless steel structures

of a second—and if the temperature of the weld spot could be lowered after fusion with sufficient rapidity, it was reasoned that carbide precipitation would not have time to occur. This actually proved to be the case.

The "Shotweld" process, as it was finally developed to weld in the manner indicated, differs from ordinary spot welding in several particulars, not the least of which is the fact that its functioning is automatically controlled once it has been set to give a specific weld strength. There are four variable and adjustable factors: (1) the diameter and shape of the copper electrodes; (2) the pressure with which they close on the work; (3) the strength of current passed through the work; and (4) the time the current is allowed to pass. The "Shotweld" machine takes current at normal line voltage and transforms it to a current of extremely high but controlled amperage, and of low voltage. This current is then passed through the work for a controlled short time by means of a pair of heavy copper electrodes which close on the work generally under controlled pneumatic pressure. In making a single spot weld by this process, the electrodes are first brought into contact with the work and then the electric current is passed through so as to produce about an 80 per cent fusion of the spot. Following the short period of current passage the electrodes immediately serve as chill plates for cooling the weld so quickly that carbide precipitation cannot take place.

An important feature of the machine is that a printed record of the current passing is made on a paper tape for every weld produced. Furthermore, should conditions change during welding so that the weld strength desired is not being obtained, a bell rings and the machine shuts down until the engineer in charge corrects the setting.

Several types of electrode are employed, depending on the sort of work being done. The type most used is in the form of a pair of tongs or a U carrying one fixed and one movable electrode, the latter being forced against the work by pneumatic pressure. Another type which is capable of welding at any point in a large sheet of metal consists of a copper-topped table serving as the fixed electrode, with a swinging arm carrying the movable electrode. For seam welding to produce a continuous joint, roller electrodes are used. These are forced together against the work which is then moved between them. Automatically administered impulses of current then produce a series of overlapping spot welds which are gas- and liquid-tight.

Since the success of the process on 18-8 steel depends on rapid cooling, too great a thickness of metal cannot be used. At present the practical limit of thickness for seam welding is $\frac{3}{64}$ in. For welds of the individual spot type two pieces up to $\frac{3}{16}$ in. each in thickness can be joined, or for a pile-up of pieces, a maximum of $\frac{3}{8}$ in. can be handled.

In the fabrication of equipment, the only limit on maximum size so far encountered by the Budd company has been the ability to transport the equipment to the purchaser. Pressure limits for closed equipment have not been fully determined, but appear to depend not on the weld, but only on the working strength of the parent metal and the diameter of the vessel. Lapped-joint tubing of 0.050 in. thickness in diameters up to 8 in., for example, easily withstands pressures to 200 lb. per sq.in. with a factor of safety of 5 to 1 or better, depending on diameter.

Many interesting design features have been developed in attaining high strength with the light gages of metals that are used. Some of these are indicated in the accompanying sketches. The fabricating methods employed in attaining such designs contribute, themselves, to the finished strength of the structure through the cold work which they produce. For example, various forms of channels and ells are largely used for stiffeners and structural members, and these are produced by drawing through a multiplicity of rolls, each set of which does its share of cold work on the metal by gradually forcing it towards its finished shape. Certain forms are produced by pressing into dies, while others are spun, as in the case of small dished heads. A type of press known as a break is employed to a large extent in bending and otherwise forming smaller members.

Unusual as the products of these forming methods may appear in comparison with better known means of process equipment fabrication, they seem nonetheless to offer attractive advantages in reduced weight, combined with a high degree of corrosion resistance. Chemical engineers in the past have rarely given much consideration to weight reduction in their equipment. Still, where manual labor can be lightened and thus speeded up, where power can be saved, or where foundations and supports can be simplified or reduced in cost through lighter equipment, the possibilities of light-gage stainless steel construction certainly appear to justify thorough exploration.

Electroforming With Iron

The process produces molds and dies by electroforming iron against a pattern it is desired to reproduce. It offers a saving and makes possible more ornate articles.

The EKKO process is a new method for the preparation of molds and dies which grew out of researches by the United States Rubber Co. on the production of cheaper tire molds. During the course of this development but before tire molds were an accomplished fact, it became obvious that this method offered advantages to almost all industries using molds and dies. The molds and dies produced effect a savings for the customer or permit him to produce more ornate and attractive articles hitherto prohibited by tool costs.

The application of EKKO to other than tire molds was investigated with increasing interest and success until early in 1939 when it was decided to establish within the company a department making these products available to industry at large. The Detroit plant was chosen as the site for this work.

The process produces molds and dies by electroforming iron against a pattern it is desired to reproduce. Electroforming is the same as electroplating except that deposits up to ½-in. thick are produced instead of the much thinner metal applied by the usual electroplating processes.

When heavy electroformed deposits of iron are separated from the underlying pattern, a cavity or die insert is obtained which has reproduced the shape and surface finish of the pattern in every detail. This cavity or die when properly mounted may be used to mold or stamp objects the exact shape of the original pattern.

An illustration shows a tire mold made by the usual process of engraving where the tread design and cavity are cut out of a steel forging with special engraving machines. The steel forging is later mounted in a cast iron back called a watch case.

One mold is produced by engraving and reproduced as many times as desired by electroforming. The engraved mold, after the addition of a spacer ring is used to mold the pattern which is later covered with iron by electrodeposition.

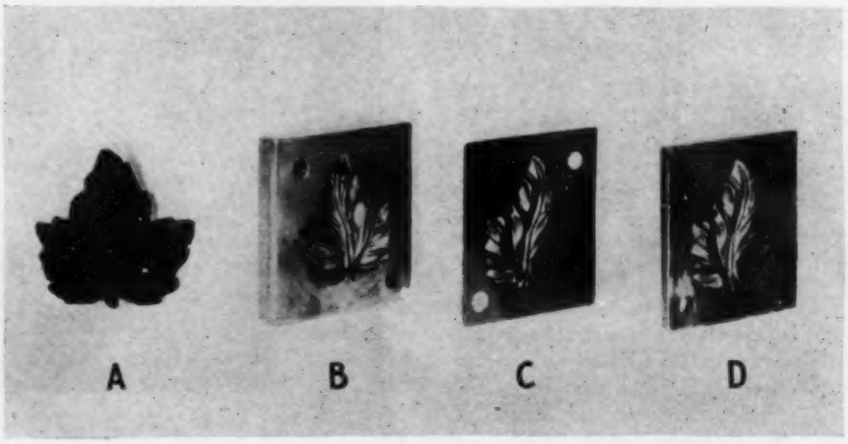
The electroformed tire mold can be made at a considerable saving over the engraved mold because it requires considerably less labor and can be mounted in watch cases already available from obsoleted molds.

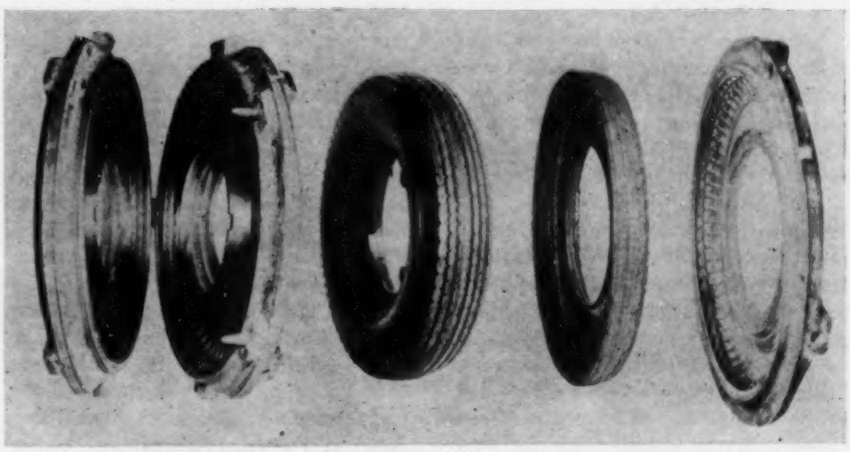
Patterns upon which to deposit the iron need not be of rubber as in the preparation of tire patterns. Provided the surface is made conducting, wood, glass, plastics, or similar materials may be used; any metal is satisfactory with the exception of zinc and aluminum which are attacked by the plating bath.

The important points in the application of EKKO to the preparation of dies and forces are illustrated. A plastic brooch "A" was used as a pattern upon which to electroform the cavity shown at "B." It was then decided to prepare a punch or force to match this die so that the brooch shape could be stamped in metal .015 in. thick. To do this the cavity "B" was returned to the plating tank and .015 in. of non-adhering iron "C" was plated. The new surface created was then treated for non-adherence and the force shown at "B" was plated, obtaining a sort of sandwich of "B, C and D."

The illustration shows the sections after separation and the die "B" and force "D" now have the proper clearance to stamp metal .015 in. thick. It has not been possible to make the die and force for a die set by starting with any one of the three pieces corresponding to "B, C or D." It has been impossible to carry great detail through to the electroformed die or force when the intermediate section (C in the sample) is .025 in. to .030 in. but it has been found it is adequate especially when the same detail is seldom required on both halves.

Top—Points in application of the process to preparation of dies and forces
Bottom—A tire mold is reproduced as many times as desired by electroforming

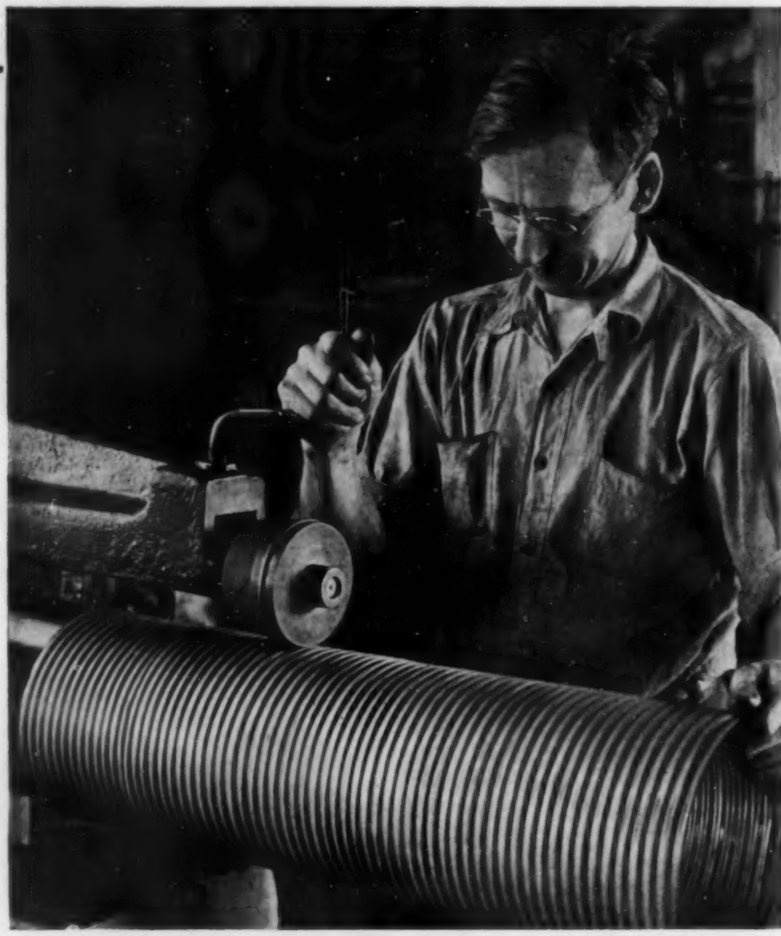




In the Wake of a Sit-down Strike

Since Fansteel won for all industry the momentous Supreme Court decision against sit-down strikes, the company has improved employee relations, recognized an independent union and increased operating efficiency by 20 per cent.

H. E. FLEMING
Based on Interviews with
R. J. AITCHISON
President,
MAX SWIREN
General Counsel,
A. J. ANSELM
General Superintendent of Plant
J. A. TEECE
Personnel Director,
and the Members, Officers and Attorney for the Metallurgical Workers Union
Fansteel Metallurgical Corp.
North Chicago, Ill.



Fansteel employee back at fabricating tantalum after 9-day sit-down strike

In February of this year, Fansteel Metallurgical Corp. of North Chicago, Ill., won for all industry the historic U. S. Supreme Court ban on sit-down strikes and on violence in any other form. Since that time and in fact since the strike of February, 1937, the company has made marked progress in its employee relations. Constructive evolution of personnel policy has gone forward with favorable results. Robert J. Aitchison, president, has been enabled to report a net profit of $100,177 for the company for the first half of 1939.

The post-strike developments in industrial relations at Fansteel stand out in contrast with the situation there in prior years. Employee relations had been taken for granted. Mr. Aitchison became general manager in 1932, at the instance of banking creditors. Utilizing his experience as a certified public accountant, he concentrated on finances. He let it be known that any employee could talk to him, but relied chiefly on the intimate relationship between management and men for satisfactory relations. He had found that in North Chicago, where Fansteel's seventeen buildings are situated, and in adjoining Waukegan, Fansteel long had enjoyed the reputation of being "a good place to work."

One reason was the regard felt by workers and other citizens for Albert J. ("Al") Anselm who had been plant superintendent since 1917. He had come up from the bench, had had his early training under "Golden Rule" Jones at Toledo, and was close to the men. But from 1932 for four years he was outside, selling to industrial concerns.

On resuming the duties of general plant superintendent in September 1936, he found that thirty of the employees in the maintenance and toolmaking department had become C.I.O. converts, under the influence of Meyer Adelman, admittedly a genial and persuasive organizer, assigned to this district by the Steel Workers' Organizing Committee.

Adelman's eye was supposed to be on the forces of four large steel products companies rather than those with

smaller forces such as Fansteel's. Now Fansteel, the name being a revision of Pfanstiehl, is not a steel company. The Fansteel Metallurgical Corp. and subsidiaries are producers and manufacturers working in four basic rare metals—tantalum and its relative, columbium, and tungsten and its relative, molybdenum. Fansteel is the world's sole source of supply of tantalum except for small production in Berlin. The metal is characterized by great resistance to all forms of corrosion. The story goes that when Adelman saw the "Fansteel" sign on one of the buildings he set out to take the company's force in his stride. Probably, however, the move was a part of the C.I.O. drive in the automobile industry, since Fansteel, one other company and a few importers supply it with tungsten for ignition breaker points.

Union Activity

In the summer of 1936 a group of Fansteel employees formed a lodge in the C.I.O. steel workers' organization. But they did not have a majority of the employees in the maintenance and production departments. President Aitchison conferred with Superintendent Anselm and stuck to a policy of opposition to dealing with an "outside union." The Fansteel management held to that position again on February 17, 1937, when the union, having gained a majority, renewed its demand for collective bargaining.

At those times, and throughout the sit-down strike which lasted from February 17 to 26, and afterwards up to April 12 of that year, when the Supreme Court at Washington upheld the constitutionality of the Wagner act, Mr. Aitchison acted on the advice that it was unconstitutional. This advice had been given by Max Swiren, of Levison, Becker, Peebles & Swiren, a leading Chicago lawyer who had handled commercial cases for Fansteel for ten years, and was generally rated as a liberal, having been active in social work and friendly toward labor. Mr. Swiren, working shoulder to shoulder with Mr. Aitchison throughout the whole proceedings, based this advice largely on the fact that none of the ten United States Circuit Courts of Appeals had upheld the Wagner Act and that four of them had said it was not constitutional.

When the 95 strikers sealed themselves by means of acetylene torches into Fansteel buildings 3 and 5, Mr. Swiren, with approval and direction from Mr. Aitchison, went around with Superintendent Anselm and the sheriff's deputies and shouted through the windows to the strikers that they were "discharged for seizure and retention of the buildings." That was fortunate for Fansteel. When the case was taken to the United States Supreme Court, this discharge was the fact in view of which the court found that, even though Fansteel had erred in not bargaining with the union, the National Labor Relations Board had been wrong in ordering the reinstatement of the strikers. It was the basis for the following statement in the majority opinion by Chief Justice Hughes.

> "The employees had the right to strike but they had no license to commit acts of violence or to seize their employer's plant. . . . The seizure and holding of the buildings was itself a wrong apart from any acts of sabotage. But in its legal aspect the ousting of the owner from lawful possession is not essentially different from an assault upon the officers of an employing company, or the seizure and conversion of its goods, or the despoiling of its property or other unlawful acts in order to enforce compliance with its demands. To justify such conduct because of the existence of a labor dispute or of an unfair labor practice would be to put a premium on resort to force instead of legal remedies and to subvert the principles of law and order which lie at the foundations of society."

This momentous decision was handed down on February 27, 1939, two years and a day after the ousting of the strikers from the Fansteel plant. In it the highest court declined to upset the action of the Illinois Courts whereby 37 of the strikers, and Adelman and another organizer, had been sent to jail in Waukegan for contempt of court, Adelman's term there running to the end of this month.

Strike Settlement

When the NLRB order for reinstatement of the sit-down strikers was thus turned down by the United States Supreme Court, there was rejoicing at Fansteel, not only by the management but also by the employees then on the job. Naturally the new employees taken on to fill vacancies in the positions of strikers not reemployed took part in this rejoicing. All during the two years of proceedings in the state courts, the parallel proceedings before the Labor Board, and the proceedings in the United States courts, these new employees had been in doubt as to the permanency of their jobs. Likewise rejoicing was in order for the 61 strikers who had been taken back, having been regarded as coerced, and for the old-time employees who had stood up against the pressure to join the C.I.O. movement. The latter two classes of employees felt that the decision freed them from coercion, and there was some coercion, judging by the stories told of visits to their homes by workers for membership in the C.I.O. union at $2 a month dues and a prospective initiation fee of $25 or more.

New Union Terms

But the Supreme Court decision contained also some slaps for Fansteel. It not only held that the company had been in error in not bargaining with Local No. 66 in February 1937, but it upheld the finding of the Labor Board that Rare Metal Workers Union, Local No. 1, organized after the strike, was a "company union." The court declared it could not say that there was not substantial evidence that the formation of this union had been brought about through promotion efforts by Fansteel. So it sustained the NLRB order that the company withdraw recognition from this union. One feature of this "promotion" had been the permitting of use of a company room for a meeting.

Thereupon the Fansteel employees held a meeting in an outside hall and organized an association named simply "Metallurgical Workers Union." They elected officers and retained as their counsel Harold J. Tallett, city attorney of North Chicago. Their dues are only 25 cents a month. They submitted membership cards to the management of Fansteel showing they had a majority of the employees. On April 17 this year this union and Fansteel signed a nine-page collective bargaining agreement under which harmonious relations between management and employees are now being carried on.

Employees are defined in this contract as all men and women employed by Fansteel at North Chicago except executive, administrative, office and sales employees, foremen, chemists, physicists and metallurgists. The production employees number 241, of whom 32 are in the subsidiary and 65 are women; 26 persons are employed in research engineering and sales; and officers and the office force number 48. One feature is that, at the request of the union, Fansteel agrees, when employing new women workers, to give preference to the unmarried.

The union is made exclusive bargaining agency for the employees with

An indirect result of the strike was an opportunity for Fansteel management to substitute women workers for men in jobs requiring a "woman's touch"

respect to rates of pay, wages, hours and other conditions of employment, except as to the rights reserved to individual employees under the National Labor Relations Act. The union agrees not to coerce employees, and the company agrees not to interfere with the union or its members.

This contract of April 17 provided for minimum hourly wages of 50 cents for men and 40 cents for women. Since then there have been two increases, made voluntarily by the management, one of 5 cents an hour for all employees and another of 5 cents for certain of them.

An 8-hour day and a 40-hour week, with time and a half for overtime are other features of the contract. Vacations with pay are provided for, one week for those in employment for two years, with one day additional for each year over two years up to a total vacation of two weeks. The agreement contains explicit provisions on seniority rights affecting reinstatement after layoff.

Grievances

A series of five steps for the adjustment of grievances is provided in a noteworthy section of this contract. In view of these provisions "the Union agrees that during the term of this agreement it will not authorize or permit any strike, suspension or stoppage of work." The union has appointed ten representatives in various departments to handle grievances.

The five steps provide that grievances shall be settled promptly by conference, first between the employee and his foremen, and then on appeal, by the union Grievance Committee successively to the foreman, the plant superintendent, an executive officer, and the president, or in his absence the chairman of the board.

In practice the employees talk over possible grievances at the monthly evening meetings of the union held in a hall away from the plant.

The second of the steps calls for an aggrieved employee to furnish the grievance committee "with a written statement of the complaint." Plant Superintendent Anselm finds that this is a very salutary provision, leading an employee to think hard as to the merit of any possible grievance. Only two grievance letters have been submitted since April, and they were withdrawn. But the system has put the foremen on their toes, to prevent occasions for grievances arising.

That a joint meeting of the union Grievance Committee and the plant superintendent shall be held on the first Tuesday of each month is one of the key provisions. From month to month, a few days in advance of that day, the union officers have been reminded of that provision by Major J. A. Teece, formerly purchasing agent, appointed on April 1 as Fansteel's first personnel director. But up to the time when this was written, in July, they have said they had nothing to bring up, and the meetings have not been held.

Industrial Relations

The appointment of a personnel director to give that phase of management full-time attention is but another evidence of the fact that Fansteel's experiences have led its management to a recognition of the importance of industrial relations as a continuing problem of as much importance as those of research, sales, finance, or production. Another reason for naming a personnel director is found in the large amount of new Federal and State labor legislation, including that governing unemployment compensation. A part of Major Teece's work has been to stabilize employment, with efforts to avoid spurts and layoffs.

Ahead of that is a placement program, involving interviewing and recording concerning each applicant for a position. An "Interviewer's Rating Scale" adapted from the best in use in the North Chicago-Waukegan industrial district is in use by the Fansteel personnel director. Although his office adjoins that of the president, he circulates freely among the employees and is as readily available to the individual men in the plant as to the management.

Safety Record

In addition, the personnel director conducts a very thorough safety program, with the aid of a safety committee made up of an assistant superintendent, a mechanical engineer and a plant engineer. In addition nonsupervisory employee inspectors in the various departments are appointed to serve for a month to look out for hazards. Already over 100 recommendations, mostly on little things, but all making for safety, have been made by these employee inspectors and adopted. For example, in the chemical building, a glove with a gauntlet having a rim to prevent liquid from running down onto the sleeve was introduced as a result of such a recommendation. Another example was the discovery by an employee inspector of several open switches in the wire-drawing department. They were replaced with closed switches, insuring against shocks.

The safety improvements have been especially interesting because President Aitchison takes pride in the company's record of freedom from serious accidents. Though faced with hazardous conditions of the work, the company has had no serious personal injury or death from accident in its thirty-one years.

In furtherance of the safety program Fansteel has established a well-equipped first-aid room with an arrangement whereby a girl inspector of product, who has had training in nursing, drops the inspection for first aid work whenever an employee reports for such attention. Furthermore, the company is now providing for examinations by an oculist for all employees and is encouraging them to have physical examinations.

Employee's Guidebook

The printed word also is being used to promote good understanding. On July 1, 1937, about four months after the sit-down strike, there was issued the first "Fansteel Employee's Guide Book—Regulations Governing Conduct of Employees." This booklet, written by Allan L. Percy, advertising manager, with the collaboration of Mr. Anselm, is explicit but friendly in

tone. Its subheads are "Care of Materials, Hours of Work, Entering or Leaving Plant, Automobiles, Safety, Fire Hazard Regulations, Termination of Employment, Change of Address, Intoxicants, Courtesy, Our Aim." Its Foreword says in part: "Not to impose hardships upon anyone, but to create and maintain a definite understanding between all concerned, it is necessary to make and enforce certain regulations. You are expected to keep this booklet, familiarize yourself with its contents, and abide by them."

The back cover has a tear-off slip carrying the following line, after a space for date and above spaces for an employee's signature, clock number and department: "I have read the regulations listed in the Fansteel Employee's Guide Book and hereby agree to abide by them."

A change in arrangements for maintenance of plant, particularly as to carpentry followed the strike. The interior of the chemistry building, a wooden structure, has to be restored frequently because of the effects of the chemicals. Likewise panes of glass in several of the buildings need frequent replacement. Formerly there was a crew of fourteen maintenance men on this work, busy sometimes, idle others. Since they had been long with the company they were kept on even though the desirability of having this work done by contract as needed had often been considered. But when those men became the nucleus of the C.I.O. group and took part in the sit-down strike, President Aitchison decided to arrange to let this work by contract. It now goes to Waukegan contractors employing A.F.L. union carpenters.

Another organization change made possible by the strike was the hiring of girls for some thirty positions for which they are better qualified than men but from which Mr. Anselm had been reluctant to let out the men who had held these jobs. This was notably the case in the cutting department, where tungsten rods are cut off with circular carborundum wheels. This is not an automatic operation, and it requires a delicate touch, for which women's fingers are deemed better suited than those of men.

Improved Relations

General Superintendent Anselm estimates that all in all, as the result of the improved employee relations in the Fansteel organization since the strike there has been a 20 per cent increase in efficiency. That the direct damage from the strike had been $60,000 and the cost of restoring property and of proceedings before the Labor Board and in the State and Federal courts had been $75,000, were points made by Attorney Swiren on June 14 last before the Senate Committee on Euducation and Labor. While the damage was partly covered by insurance, it will take some time for the loss to be overcome by the increased efficiency.

Intangible benefits included messages of encouragement during the strike from the company's customers and later letters of congratulations on the Supreme Court victory from business executives in all parts of the country. One of the Fansteel family jokes is that "Fansteel's 'fan mail' is greater than Clark Gable's."

"Our relations with all of our employees, including those we took back after the sit-down because they had been misled or coerced, are closer than ever before and there is fine cooperation between all departments," said President Aitchison to the writer in answer to questions on the present situation.

Company Liberalized

As to the general effect of the whole experience on himself and his management, he said, in characteristic forthright manner: "You could either be embittered or liberalized by an experience like ours. I think I have been liberalized. I am sure that the management must be firm, maintain respect, and not count on fraternizing with employees. But by being liberalized I mean we believe in explaining more to the employees and in giving more attention to employee relations. That is why we now have a personnel director, one of our long-time men, promoted to this work. He was chosen for it partly because he did a good job when purchasing agent in sizing up salesmen callers and in lining up for our own salesmen points about them, and partly because of his experiences and attitude in our organization and also in the National Guard in dealing with men."

Attorney Swiren stated to the writer that the principal lessons for other companies in the Fansteel experience are two:

"First, even with a small company, recognize labor relations as a constant, real and special problem that can't be taken for granted as a part of general activities, but is one requiring specialized and constant attention.

"Second, your own employees respect you more when you stand firm for your principles."

Conclusion

To the independent observer it appears that probably very few companies can, without violating the Wagner Act, get into Fansteel's situation as to an independent union, made possible for that company by the circumstances of and after the sit-down strike. However, every company would do well to take note of another of Attorney Swiren's points, namely, that it can safely let its employees know that any act of violence, done while at work or on strike, is a basis for discharge, and that after a discharge for violence the National Labor Relations Board, in view of the United States Supreme Court ruling in the Fansteel case, cannot order the employee's reinstatement.

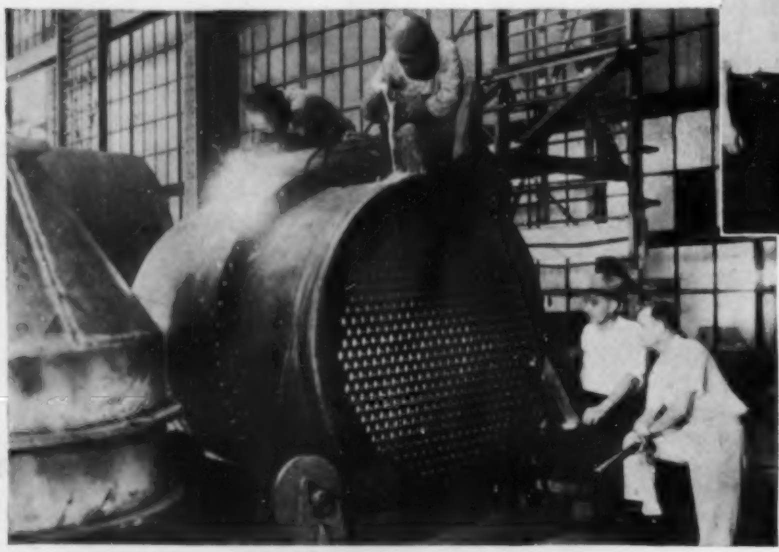
The outstanding general observation of this writer, however, is as follows: Certainly if a company which has won such a victory as Fansteel's, and one whose employees feel protected from outside pressure by labor organizers, has found it desirable to strengthen its employee relations and personnel policy and administration, others not having gone throuch such a battle nor experienced such difficulties would do well to do likewise.

Tantalum ore goes through a series of exacting chemical treatments in the preparation of chemically pure salts which are reduced to the metal

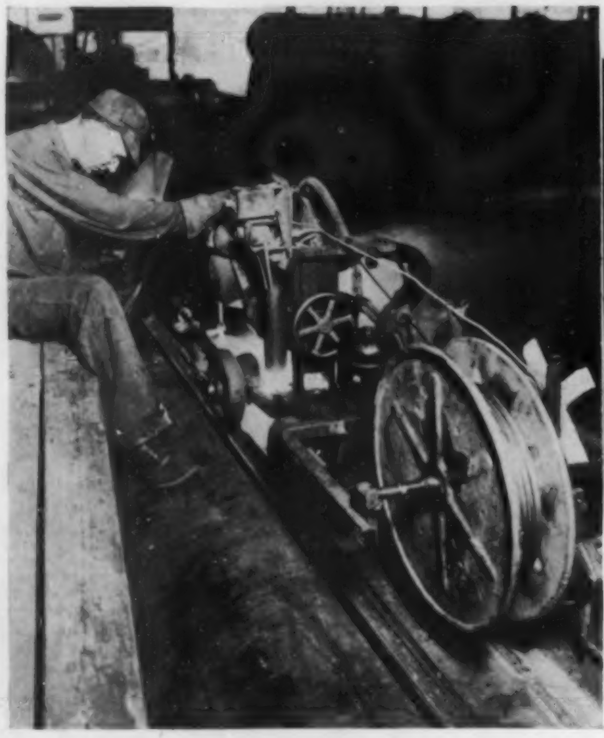
WELDING

IN THE NEWS

With the approach of October 23–27, the dates of the 20th Annual Meeting of the American Welding Society which is to be held in Chicago, welding is in the news. Hardly more than ten years has elapsed since welded process equipment constituted a minor percentage of that fabricated by riveting. Today it is no exaggeration to say that the reverse is true. In the accompanying views are shown some of the new tools that welding engineers have made available for equipment fabrication.



Here are two views of the construction of a Swenson LTV evaporator for black liquor. Above, two operators are welding the girth seam of the expansion joint. At the left, the longitudinal seam of the heating element is being welded. The spectators are Walter De Vries, plant manager, and L. S. McPhee, welding supervisor of the Whiting Corp. in whose plant the views were taken.



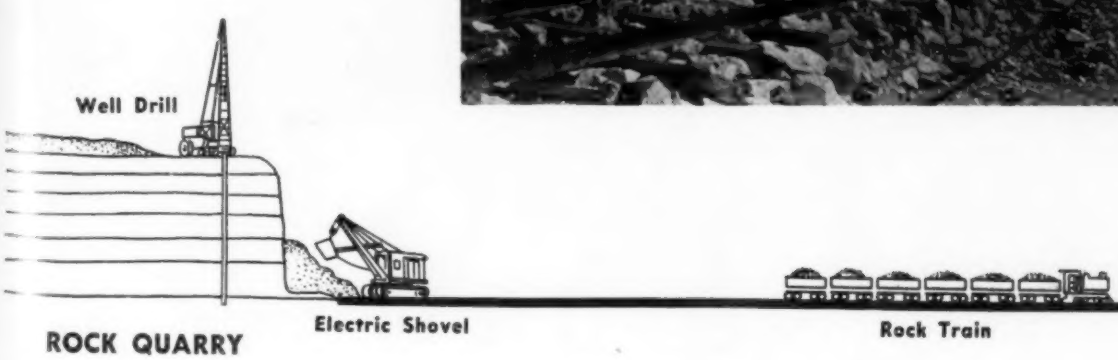
Chicago Bridge & Iron Co. fabricates much heavy equipment by means of welding. At the left an operator is supervising the work of a Lincoln Electronic Tornado automatic welding machine as it closes the longitudinal seam of a large pressure vessel. Above, an Oxweld cutting machine is scarfing the edge of a plate in preparation for welding.

Wet Processed Cement

PORTLAND cement was first produced in the United States over 50 years ago. The industry has grown rapidly in size, so that today more than 90 companies with over 150 plants manufacture cement. A typical modern cement mill is that of the Lone Star Cement Corp. at Hudson, N. Y. This plant, which uses the wet-blending process requires for making 6,000 barrels of portland cement a day, 1,800 tons of limestone and shale or clay, 330 tons of fuel (coal), 45 tons of gypsum, 950 lb. of lubricants, 750 lb. of explosive and 150,000 kw.-hr. The raw materials pass through 72 separate operations. Limestone is reduced to a maximum of 6 in. in diameter in a gyratory crusher and then further reduced in a hammermill. It is next mixed with other ingredients and ground in a preliminary mill to about 1/25 in.

The slurry goes to tube mills where it is ground to a fineness so that 94 per cent passes through a sieve having 40,000 openings per square inch. Water is extracted from the slurry and the resultant filter cake is fed into the upper end of a revolving kiln. This material is gradually heated in the kiln until it reaches a temperature of about 2,700 deg. F. when incipient fusion takes place, forming very hard nodules, known as clinker. After cooling, the hard clinker with gypsum added, to control setting time, is fed to preliminary pulverizers and then to tube mills for very fine grinding. The resulting product, portland cement, is stored in bins. The accompanying diagrammatic flow sheet shows the process used in the Lone Star Cement Corp.'s Hudson, N. Y., mill for the production of this material.

The first step in the production of portland cement at the Hudson, N. Y., mill of the Lone Star Cement Corp., is the quarrying of the limestone. Previously tested lime rock is drilled and dynamited from the face of the quarry, loaded by large electric shovels onto railroad cars and hauled to the crushing plant.



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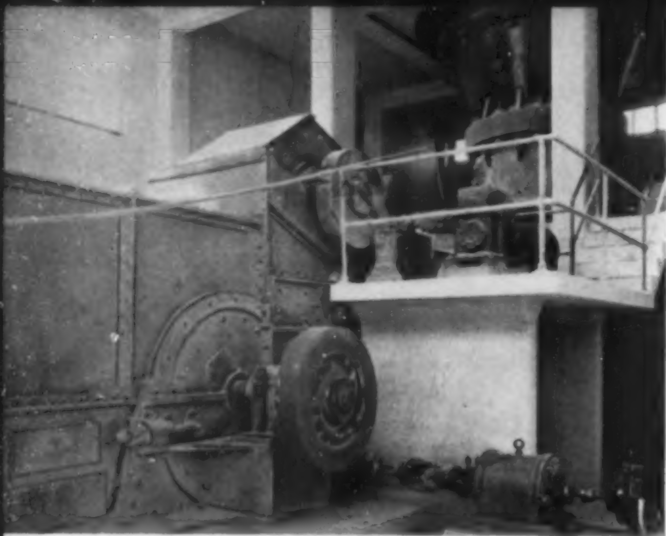
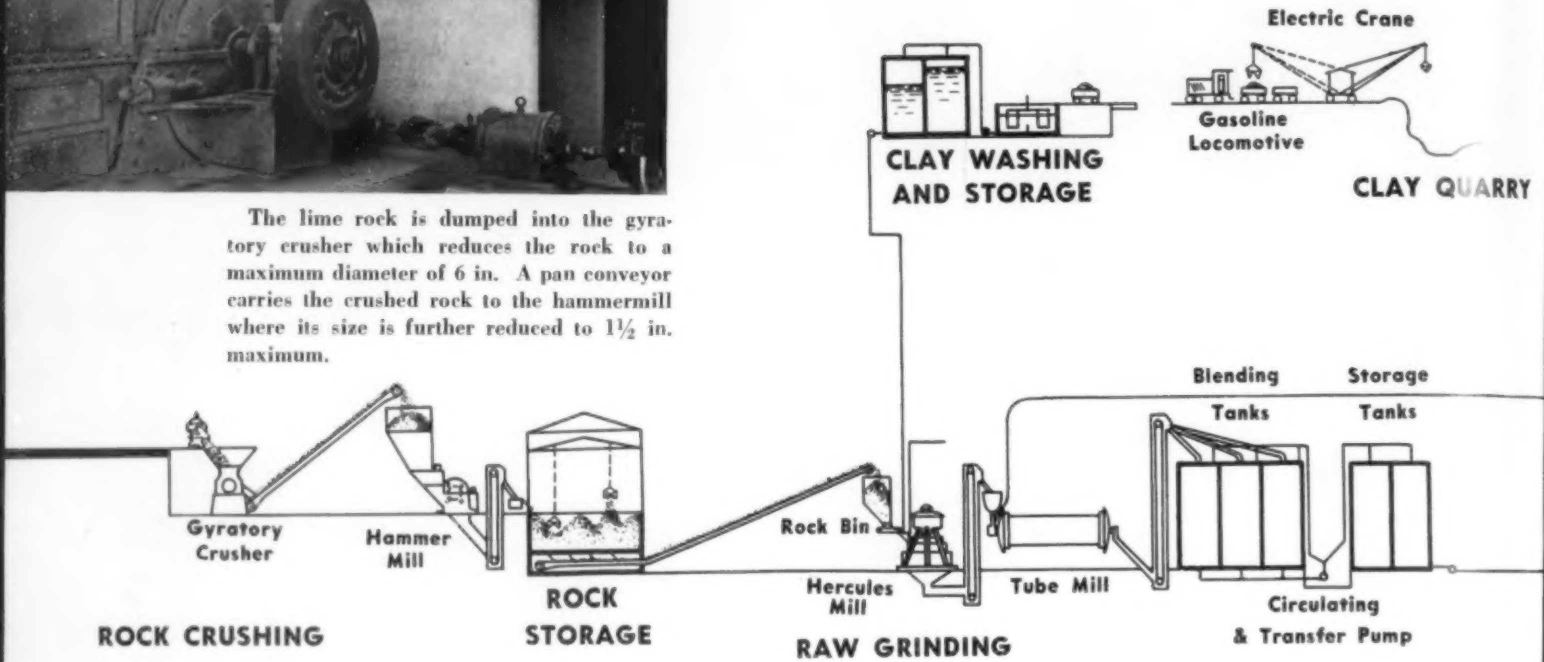
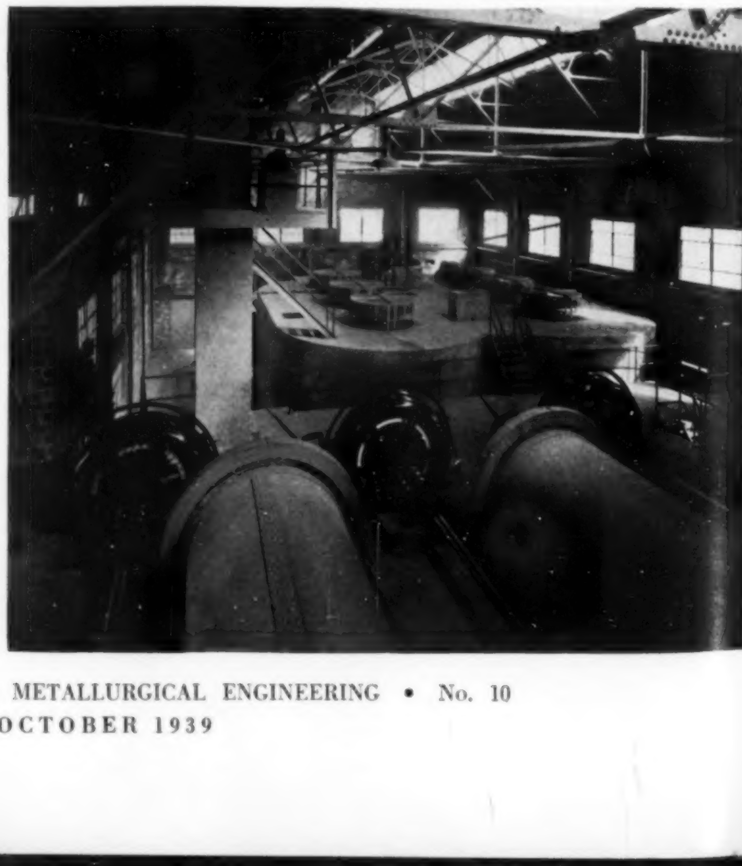


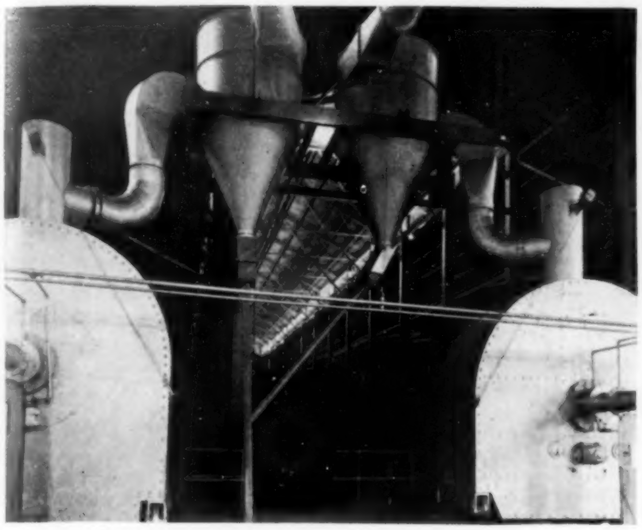
The lime rock is dumped into the gyratory crusher which reduces the rock to a maximum diameter of 6 in. A pan conveyor carries the crushed rock to the hammermill where its size is further reduced to $1\frac{1}{2}$ in. maximum.

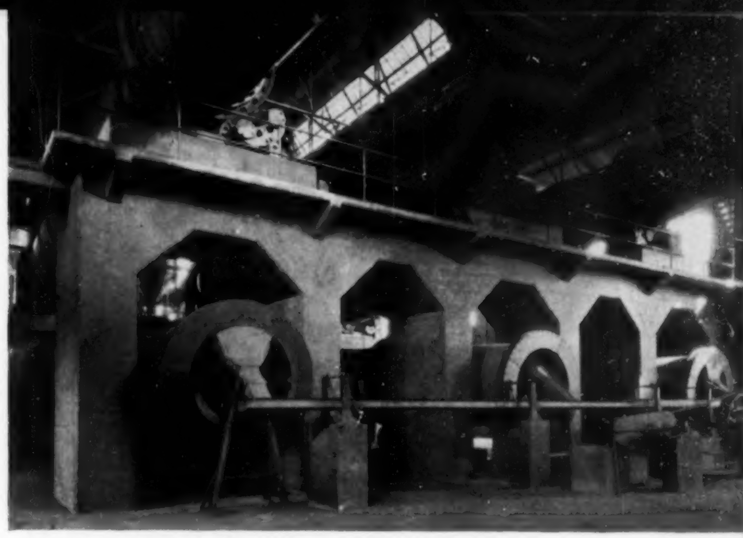


The rock then passes to the large storage bin where it is piled according to its chemical composition.

Slurry blending tanks and tube mills. Clay is dug and hauled to the wash mill where sand and other impurities are removed. The resultant slurry is placed in storage tanks. Controlled proportions of clay and water are added to the rock as it enters the Hercules mill, thereby starting the wet blending process. These mills reduce the particle size to about 1/25-in. The slurry from the Hercules mill goes to tube mills; tumbling steel balls further grind the material. The slurry is stored in large blending tanks, agitated continuously by compressed air and mechanical stirring. From storage the slurry is conveyed to drum filters where excess water is extracted. The resultant filter cake resembling a semi-dry mud is fed into the four kilns, each connected to separate waste heat boilers.

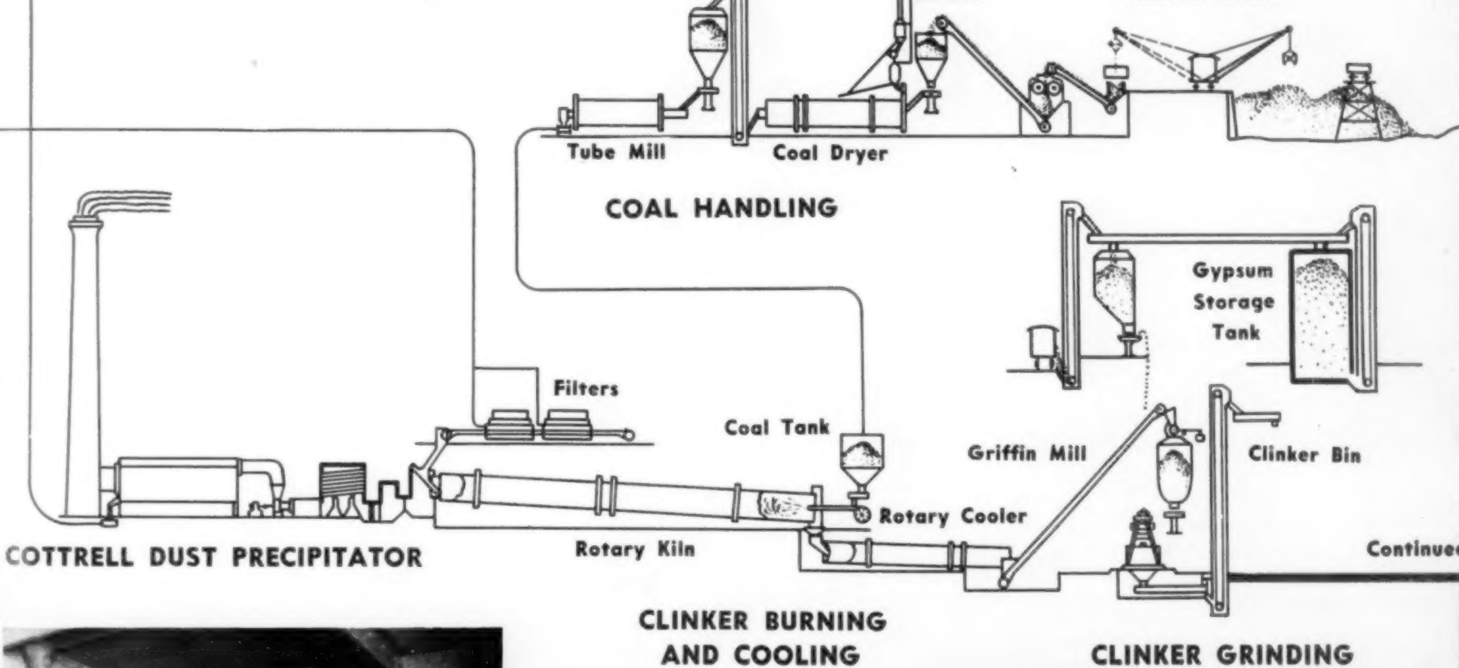


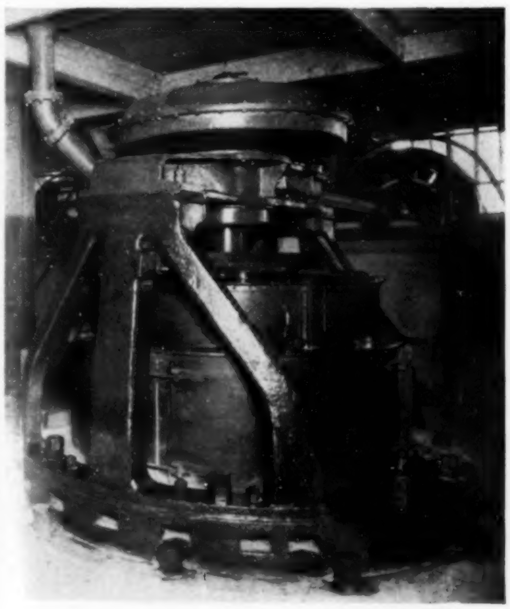




Kiln and coolers. The temperature of the kiln at one end is about 1,000 deg. F. and at the other between 2,600 and 2,800 deg. F. When the cement clinker leaves the kiln it passes through coolers, shown in the lower part of the illustration. The shaker conveyor is shown in the foreground.

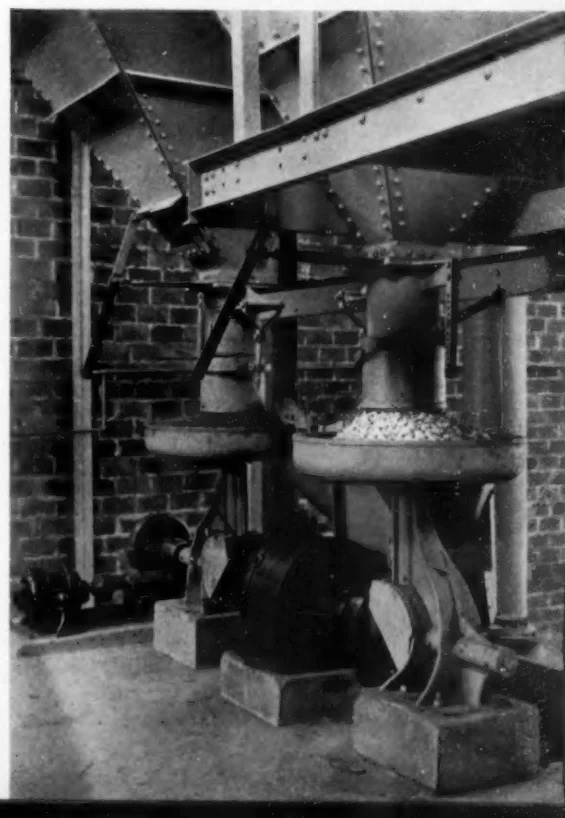
Another view in the kiln room showing the firing ends of two of the kilns.



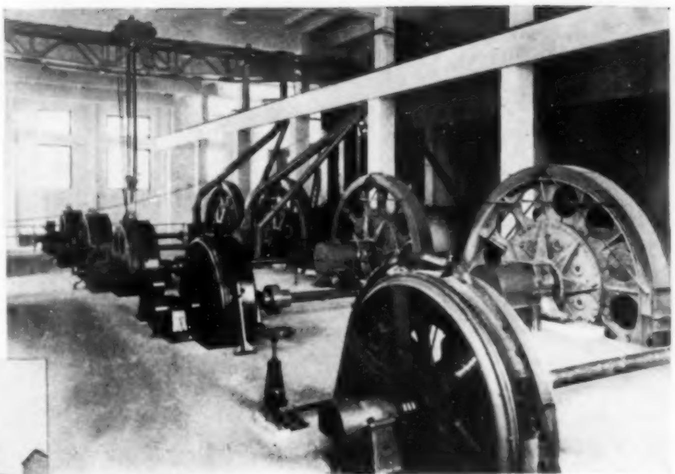


Here are shown the clinker and gypsum feeders to the mill. Above the feeders are bottoms of storage bins for gypsum and clinkers.

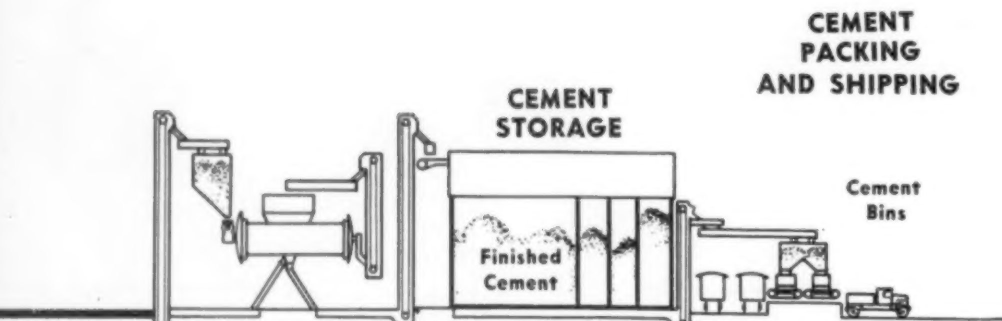
In the finish department, clinker with the addition of a small amount of gypsum, to control setting time, is fed to the preliminary pulverizers.



The material discharged from the preliminary pulverizers goes to the tube mills which grind to an extreme fineness. These mills are equipped to grind all material at one operation or to work in conjunction with air separators which classify material discharged from the mill according to size—that of desired fineness is sent to storage as finished cement. The coarser returns to the mill for regrinding.

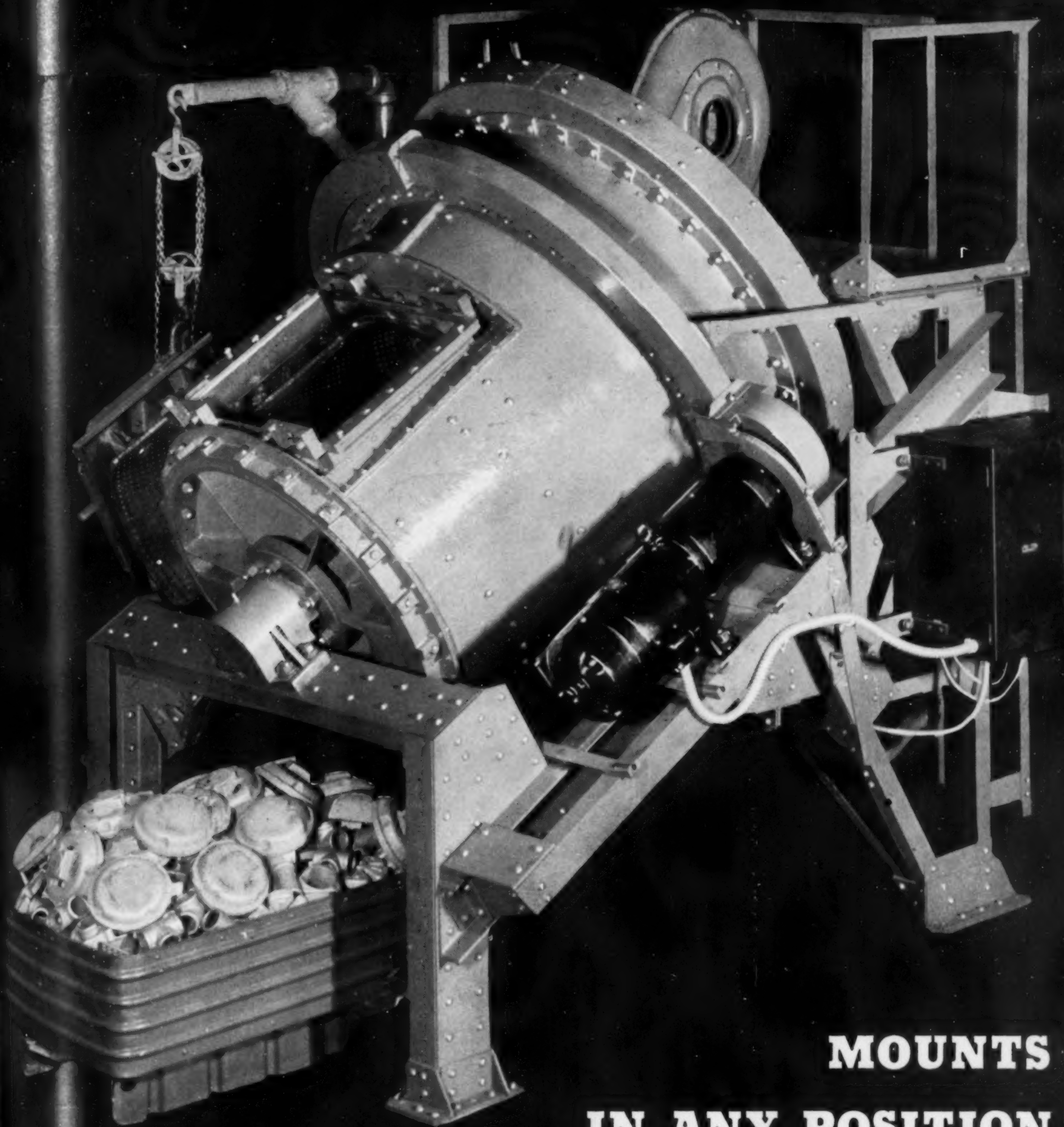


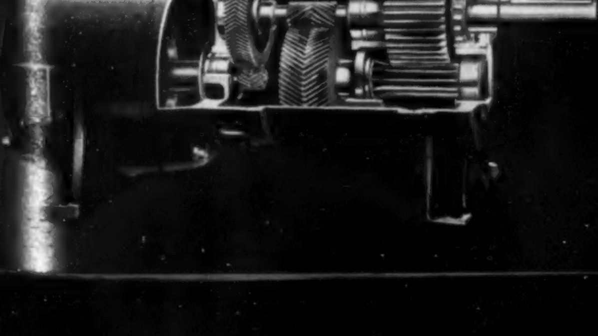
Pumped to the warehouse ready for shipment, cement is stored in bins which have a capacity of 275,000 bbl. As the demand for cement is heavier in summer than in winter, a large storage capacity enables the plant to operate on a more uniform basis throughout the year and provides steady employment for workers.



A Chem & Met PICTURED FLOW SHEET

In the packing and loading department, cloth or paper bags are filled for shipment. All bags are closed before filling. A valve in the corner allows compressed air to force the cement into the bag through a spout in the packing machine. When the bag contains 94 lb. of cement, the stream shuts off automatically and the bag drops onto a truck or conveyor and is transported into a railroad car.





Introduction to Liquid Mixing

In our May 1939 issue the senior author presented an analysis of emulsification which suggested that a somewhat similar treatment of general mixing questions might later be possible. This broader analysis has now been completed and is presented here.

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and

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MIXING is a process of achieving homogeneity, either (1) the ultimate homogeneity of which the system in question is capable; or (2) some intermediate level as determined by the requirements of the particular process. For example, while the bleaching of cottonseed oil requires the absolutely uniform distribution of the clay in the oil, the mixing of corn oil with caustic soda solution in the refining of the former demands the uniform contacting of the oil with the caustic, but not the distribution of the soap stock which is formed in the process, since the fullest distribution of this soap stock would set up an emulsion which the centrifuges could not break without great difficulty. Other instances of the second case include: the treating of lube oils (where the problem is the distribution of the treating reagent, without the setting up of a sludge suspension which would be difficult to break); and the "flushing" of pigment-vehicle formulations (where the problem consists in establishing the fullest contact of pigment with vehicle and the distribution of any wetting colloids which may be present in the formulation, without setting up an emulsion which is too stable).

However, regardless of the level of homogeneity which is desired, the work required to achieve this level of homogeneity for any defined procedure of addition, temperature, and pressure (and with a condition of maximum efficiency of work application), is a constant regardless of the type of mixer. The work required to achieve homogeneity may be latent in the system, or it may have to be mechanically supplied or it may be some combination of both. Hence, for any system,

$$W_d = W_l + W_m$$

where W_d is the work required to achieve the predetermined level of homogeneity; W_l is the latent work of the system; and W_m is the mechanical work that must be supplied by the mixer.

Mixing systems will vary in the amounts of mechanical input required (agitation as supplied by mechanical mixing units). Thus the W_l/W_d is at a maximum (approaches 1.0) for a binary combination such as a gas-gas mixing system, and a primary factor in such an instance as a blending of two miscible liquids. As we proceed through heterogeneous mixing systems, to solid-solid binary combinations, W_l/W_d is at a minimum (approaches zero) and W_m/W_d is at a maximum. The rate at which W_l manifests itself is a function of the kinetic energy of the ultimate particles of each component, or the resultant number of contacts between the ultimate particles, or the resultant area of contact.

What Latent Work Is

The nature of the latent work of which we speak is intimately bound up with the physical chemistry of solutions. This work accomplished by the latent forces, W_l, may consist in the counteraction of the forces of cohesion within the various components of a mixing system, or it may consist on the other hand of an establishment of a bond between dissimilar particles comprising the mixing system. The rise within the last few years of such concepts as the "surface-work" of particles and "wetting" tends to indicate that the bond theory is probably the more acceptable, regardless of whether it is a physical or chemical phenomenon. Latent work as conceived by the authors is the ability of certain mixing systems to attain a level of homogeneity through the establishment of physical, chemical, or "sub-chemical" bonds, the bonds being inherent in the physical and chemical relationships between the components of the mixture. The agitation which is given to systems having a relatively high W_l/W_d is for the purpose of establishing the maximum number of contacts per unit of time between the various particles of the components, thus increasing the rate of release of the latent work, that is, the rate of manifestation of W_l. In contradistinction to this, systems having a low W_l/W_d (emulsions and suspensions) may reach any stage of homogeneity of which they are capable solely through electrochemical and electrophysical properties which are imparted to the dispersed phase as a result of mechanical agitation. (See the senior author's earlier article, *Chem. & Met.*, May 1939, p. 173.) To put it briefly, the distinction between various mixing systems is the role which mechanical agitation plays—whether the agitation is a means of "catalyzing" the release of latent work of a mixing system, or whether it is itself a work-component of the system.

Mechanical agitation, regardless of the means for accomplishing it, is achieved through a shearing of the components which make up the mixing system. This shearing action is of two types, direct and indirect. Direct shear is that obtained as a re-

sult of the immediate application of force to a particle by any portion of the mixing device. In other words, direct shear is that diminution in the size of the particles or that distortion in particle shape which occurs during the period of mechanical impulse. Direct shearing may take place by the firing of particles against an impact block, the forcing of a charge through a narrow orifice, as in an homogenizer, the adhesion of a portion of the charge to a moving member against the batch inertia or the restraining influence of a "stator" member, as in a colloid mill or super turbine. Indirect shearing, on the other hand, is that reduction in particle size which takes place as a secondary result of the momentum imparted to it, that is, as a result of impacts of the impelled materials against other particles comprising the batch. The various types of mixers which are known today vary not only in the rate of shear (power per cubic foot of mixture) of which they are capable, but also in the relative proportions of direct and indirect shear obtained per unit of power consumed.

Test for Kind of Shear

To test the types of shear which each of the kinds of mixers most commonly used for liquid mixing in the chemical industry is capable, the following tests were developed:

1. Since indirect shearing proceeds through the number of impacts between particles achieved per unit of time, indirect shearing must be a direct function of the rate of translation of materials in the mixer, i.e., the circulation capacity of the agitator in question, divided by the batch size. The rate of comparative translation was determined in terms of the ratio of heat transfer through a resinous mass under various peripheral speeds of the agitators used, to the rate of heat transfer under a condition of no agitation. An alkyd resin was used as a medium so as to minimize the transfer of heat by conduction through the mass. Using the ratio of heat transfer obtained, at any peripheral speed, to the heat transfer at zero agitation, it is possible to calculate an indirect shearing index for the rotor used by dividing the indirect shear capacity (ratio of heat transfers) by the total shear rate (power consumption per cu.ft. of mixture). This indirect shear index, which may be described as the indirect shear capacity per horsepower, is plotted against the total shear rate for different general types of agitator in Fig. 1.

2. Direct shearing was tested by adding to water a screened, weighed-out charge of water-insoluble gums and by subjecting the resultant mixture to the agitation of the various types of units for a predetermined uniform length of time. A properly sampled portion of the resultant slurry was spread very thinly on paper, care being taken to cause no crushing of the crystals. The crystals were then dried and screened and the ratio of the resultant average particle size to the starting particle size calculated as a measure of the effectiveness of the unit as a means of obtaining direct shearing. Having obtained the measure of direct shearing or direct shear capacity, it is possible to calculate a direct shear index by dividing the direct shear capacity by the total shear rate. The direct shear index, that is, the direct shear capacity per horsepower, is plotted against total shear rate for different general types of agitator in Fig. 2.

Analyzing the Problem

The analysis of any mixing problem must be made in terms of: (1) the potentiality for latent work; (2) the type of shear required to achieve a maximum value for rate of release of the latent work; and (3) the maximum applicable rate of shear.

As already noted, basic to the presence of the first of these factors are the chemical, physical and "sub-chemical" inter-relationships between the components of the mixing system. Determining the second factor is the resistance to shear of the various materials comprising the mixture or, to be more precise, the resistance to shear in the face of the presence of the remaining components of the mixture. The maximum acceptable rate of shear is determined by the permissible temperature increase of the process in question, and by the maximum rate at which the latent work of the system can be released, if it is one having a relatively high W_l/W_d; or by the maximum rate of electrostatic surface charging of the dispersed component in a system having a low W_l/W_d.

To achieve a basic analysis of a mixing problem, the following method will be found highly satisfactory:

Using a well formed paddle type agitator operating at any predetermined rate of shear application, determine the amount of work, as shown by a watt-hour meter, expended by the agitator in question to achieve any desired level of homogeneity. Then at the same rate of shear application, alternate periods of "resting" of the system with periods of agitation of equal length. In this way, determine the actual consumption of work by the agitator to attain the same level of homogeneity.

In instances where the work expended under the condition of alternate "resting" and agitation is less than the work expended in continuous mixing to obtain the same level of homogeneity, we have a case of high W_l/W_d. However, where the required work for alternate mixing and "resting" exceeds (or is reasonably equal to) the work expended during continuous mixing, the system is one either having a low W_l/W_d or a low rate of manifestation of W_l under the conditions of mixing. In such a case, it is necessary to determine which situation exists. This is important, for very often systems having a low rate of manifestation of W_l are actually systems with a high W_l/W_d and, as such, should be treated as partially miscible and miscible systems, rather than as emulsions and suspensions.

The determination in this case consists in measuring the time necessary to achieve a set level of homogeneity, employing different rates of agitation. For example, a paddle is operated at peripheral speeds from 300 to 1,000 ft. per min. by increments of 100 ft. per min. to obtain a set level of homogeneity. If the time needed for complete homogenization tends to follow a linear function of the power applied, this indicates a system having a low W_l/W_d. On the other hand, if the homogenization rate tends to increase more rapidly than a linear function of the power applied, which is similar to the increase in chemical reaction rates with increasing temperatures, then it is likely that the system is one having a low rate of release of the latent work.

Once we have determined the nature of the "mix" and the role played by mechanical agitation, the procedure for determining the best type of agitation depends on whether the system has a high or a low W_l/W_d.

Miscible Systems

With systems indicated to have a relatively high W_l/W_d the procedure is based on the following argument: We have already noted that in such a system most of the mechanical input of work is employed in producing collisions between the particles and hence in releasing the latent work, W_l. That is, the release of W_l depends upon the number of collisions and the rate of release of W_l depends on the rate at which mechanical work input is efficiently applied in producing collisions. Mathematically expressed, where R_l is the rate of release of W_l and R_m is the rate of efficient input of mechanical work, this may be stated as $R_l = f(R_m)$. Therefore, since the time t to release W_l is inversely at the rate of release, $t = f(1/R_m)$, or, at two different rates of mechanical power input, R_m and xR_m (where x is the ratio of the larger power rate to the smaller), the ratio of times, t to t', required to achieve a predetermined level of homogeneity, will be:

$$\frac{t}{t'} = f(xR_m/R_m) = f(x)$$

It has been determined experimentally that $f(x)$ is actually a power function and hence the time ratio may be expressed as

$$\frac{t}{t'} = x^n$$

As the mechanical power input to any mixing system is increased, a point is reached where either the maximum possible value of R_t is attained, or the efficiency of the agitator begins to decrease rather suddenly and sharply. Hence, the indication of the equation above that it should be possible to decrease the mixing time indefinitely by increasing the power is not true. What actually happens as the peripheral speed of the agitator (and hence the power) is increased is that some substantially constant value of n is maintained until a point where it suddenly begins to fall, as mentioned above. This point is determined as in the following discussion.

Tests With Paddle

A well formed paddle is rotated at various constant peripheral speeds, agitating the test material to a set level of homogeneity at each speed. Using increments of 100 ft. per minute, tests are made at 300, 400 and so on up to 1,000 ft. per minute, recording the time and the power per cubic foot of mixture to attain the set level of homogeneity at each speed. In a hypothetical test, the times and power rates might be as in Table I for a number of these speed increments. Having completed the test, then calculate for each of the intervals 300 to 400, 400 to 500 ft. per minute, etc., the value of n from the expression $n = \log t/t'/\log x$. It will ordinarily be found for most cases that the n determined for the 300 to 400 ft. per minute interval will remain substantially constant in the other intervals (drop not more than 10 per cent) until it suddenly begins to decrease quite sharply (except that in high viscosity mixes, n begins to drop almost immediately and very sharply). It is now necessary to discover whether the decrease in n at

Table I—Time and Power in a Hypothetical Mixing Problem

Required time	$t/t' = x^n$	Hp. per cu. ft.	x	n
20	....	1	....	....
12.3	1.63	2	2	0.7
9.3	1.33	3	1.5	0.7
7.5	1.22	4	1.33	0.7
6.4	1.17	5	1.25	0.7
5.6	1.14	6	1.20	0.7
5.1	1.09*	7	1.167	0.6*
4.75	1.07	8	1.142	0.5
4.5	1.05	9	1.125	0.4
4.35	1.03	10	1.111	0.3
......	......	....	....	....
4.0	*5.0*	*10*	*10.0*	*0.7*
4.35	*4.6*	*10*	*10.0*	*0.66*

* Note change in n at this point.

this point of failure was due to the reaching of a maximum for R_t, or to a failure of the paddle for either direct or indirect shear.

The simplest way to do this is to calculate the per cent decrease in x^n in the first peripheral speed interval of the test after the point of failure, compared with x^n in the 300 to 400 ft. per minute interval (where it is known that a paddle operates most efficiently). Then, in the same shear rate (horsepower per cu.ft. of mixture) interval in Figs. 1 and 2, calculate the per cent decrease in the two shear indexes as taken from the curves for the paddle from the expression $[(I_{300})^n - (I_f)^n]/(I_{300})^n$ where I_{300} is the shear index at 300 ft. per minute and I_f is the shear index on the curve at the shear rate corresponding to the point of failure. If the x^n percentage compares with neither shear index percentage, the reaching of the maximum possible R_t is indicated, in which case more powerful agitation will be found to be of little avail in decreasing the mixing time. However, if the x^n percentage is of the same order of magnitude as the percentage decrease for one or the other of the shear curves, then a failure of the paddle for the corresponding type of shear is indicated.

When paddle inefficiency appears to be at fault, it is next necessary to find whether another form of agitator might not give the desired mixing time efficiently. On the assumption that n remains substantially constant, even at the power input required to give the desired mixing time, calculate what this power input would have to be from the expression $t/t_d = x^n$ where t is the time required

Fig. 1—Indirect shear index for various types of mixer at various shear rates

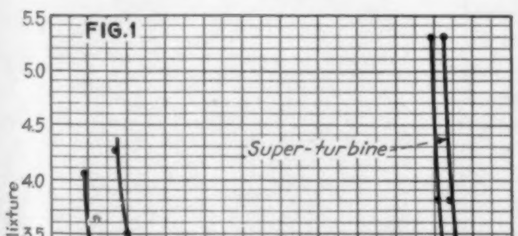


Fig. 2—Direct shear index for various types of mixer at various shear rates

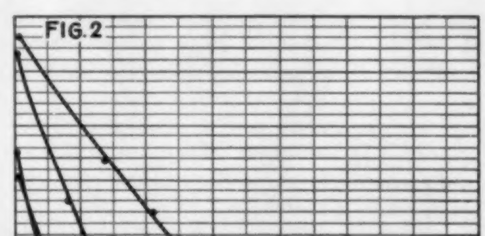
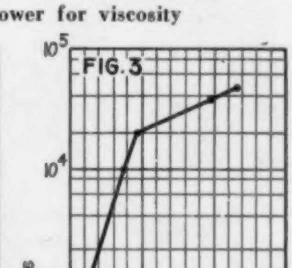


Fig. 3—Factor for correcting mixer power for viscosity



at 300 ft. per minute, t_d is the desired mixing time, x is the ratio of required power input to power input at 300 ft. per minute, and n is the value calculated for the 300 to 400 ft. per minute interval. (For example, the hypothetical figures of Table I show n equal to 0.7 to the point of failure. The upper row of italic figures shows the result of the calculation above as $x = 10.0$ where the required mixing time is 4 minutes.)

Having calculated this theoretical value for the required x, actually increase the speed of the paddle until the power rate is x times that at 300 ft. per minute (i.e., to 10 hp. in the hypothetical problem of Table I). At this rate determine the time t_e actually needed for the mixing. This will be more than t_d (4.35 minutes in Table I), since n will have decreased before this high value of power input is reached. Then substitute t_e in the expression $t/t_e = x^m$ and calculate m ($m = 0.66$ in Table I, as in the second row of italic figures). The "percentage of failure" is then calculated as $(x^n - x^m)/x^n$, which gives a measure of the amount by which the paddle failed to give the desired mixing time at the power rate indicated by a constant value of n.

Assuming that it was found that the inefficiency of the paddle for indirect shear was probably at fault, refer to Fig. 1, the chart for the indirect shear index, and read the index for the paddle at the power rate which gave the experimental time t_e. This value of I_e corresponds to too small an indirect shear capacity to give the desired mixing time and so must be increased according to the

equation $I_r = [I_e^n/1 - \frac{(x^n - x^m)}{x^n}\cdot]^{1/n}$

where I_e is the experimental and I_r the required index. It will generally be found that several types of agitator are capable of delivering the required shear index.

In order to determine which types of agitator can give the desired shear index, it is necessary to work in terms of shear capacities, which it will be recalled are shear indexes multiplied by the corresponding shear rates. The value of I_r multiplied by the corresponding horsepower per cubic foot therefore gives the shear capacity needed to accomplish a certain mixing job in a certain time. Referring to Fig. 1 it is evident that for the same shear rate the other units all give higher shear capacities than the paddle. Hence (1) the required shear capacity can be obtained with some or all of the other units at a lower shear rate or (2) the higher shear capacity to be obtained with the other units at the same shear rate can be employed to reduce the mixing time as compared with the paddle. If course (1) is to be followed, picking one of the units of higher shear index, determine at which shear rate on the curve the same shear capacity will be obtained. If course (2) is chosen, at the same shear rate as with the paddle determine the shear index of the selected unit and hence its shear capacity. Then the ratio of the mixing time for the paddle to that for the selected unit will be inversely as nth power of the ratio of the corresponding shear capacities.

In case inefficiency of the paddle for direct shear seems to be the trouble, exactly the same sort of correction is carried out as for indirect shear, using the paddle curve on Fig. 2 to find the required direct shear. The other curves then show the types of agitator capable of supplying it.

In either case the required shear capacity may correspond to several different units, each requiring a different shear rate (horsepower per cubic foot of mixture). Where direct shear seems to be the determining factor, the most economical unit (i.e., the one needing the least work input) may not be the best since other factors such as proper heat transfer (rate of translation) may demand greater than the minimum power. With indirect shear the determinant, generally the most economical unit can be used, although even here a unit giving an amount of direct shear approximately equal to the indirect shear may be a wise choice.

In using this method to predict the power requirements for mixing, one further fact must be taken into consideration, namely, that Figs. 1 and 2 are based on tests corrected to water viscosity. Hence the shear rates indicated by their use must be corrected for the viscosity of the actual mix. To do so the shear rate determined as noted must be multiplied by whatever factor is given in Fig. 3 for the actual viscosity of the mix. Careful use of the tests described here will give surprisingly accurate results, as has been shown by much experimental confirmation.

Immiscible Systems

In attempting to apply the concepts developed previously to systems having a low W_e/W_d, that is, emulsions and suspensions, certain complications are encountered. (See the senior author's earlier article, *loc. cit.*) Unlike systems having a high W_e/W_d (miscible liquids), the contact between phases is greatly reduced owing to the fact that in emulsions, the particle sizes are of the order of microns, in contrast with the molecular dimensions of "true" solutions. Hence, because of the decrease of interphase contacts, the factor of W_e is greatly reduced. Where in miscible and partially miscible liquids the approach is along the lines indicated in the present article, the approach to the problem of producing or preventing emulsions is solely through electrochemical and electrophysical properties imparted by mechanical agitation. In other words, where in miscible phases mechanical agitation merely tends to "catalyze" the rate of release of W_e, in the case of emulsions and suspensions the mechanical agitation is actually a work component of the system. Differently expressed, in the first case the agitation affects the rate of release of the internal or potential energy of the system quite like temperature or pressure in a chemical reaction, while in the second case, the agitation represents an amount of work input that is necessary to arrive at a certain desired energy level of the system, quite like the endothermic heat of reaction in certain chemical reactions.

In summary, it has been the authors' contention in this article that agitation as applied to the solution of chemical problems has a sound theoretical background which, although not as fully developed as the concepts of temperature and pressure to which it is compared, may very well be raised to an extremely important position in the chemical and physical theory of today. In the development of this contention certain assumptions were made as a result of experimental observations and theoretical trends in the modern physical and chemical world.

First it was claimed that solution is a type of reaction, the exact nature of which was not suggested although some preference was shown to the "bond theory." A concept of latent work (ability to achieve a level of homogeneity through the establishment of physical, chemical, or "sub-

(Please turn to page 639)

New Low-Capacity Sulphur Burner

A new design of sulphur burner for handling from 1½ to less than 100 lb. of sulphur per hour, practically without attention and with a high degree of controllability, has been developed by the Freeport Sulphur Co. for small consumers of sulphur.

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and
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Hoskins Mound Laboratory
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Hoskins Mound, Tex.

A SULPHUR BURNER designed specifically for burning small amounts of sulphur, less than 100 lb. per hour, at accurately controlled rates that can be varied over a wide range, has been developed at the Hoskins Mound Laboratory of the Freeport Sulphur Co. Practically all the developments on sulphur burning equipment have been made on burners of the rotary and spray types that are used in sulphuric acid plants. While these burners are satisfactory in their usual operating range they are not adapted to operation on a small scale. On the other hand the ordinary small-scale sulphur burner does not permit the accuracy of control and simplicity of operation that is necessary in many cases.

In many processes, particularly in water and sewage treatment, it is frequently desired to add sulphur dioxide or a dilute acid and the most economical way of doing this is to use sulphur dioxide made by burning sulphur. The first installation of one of these burners was for the purpose of treating boiler feed water to deaerate the water chemically and to adjust the sulphate-alkalinity ratio. In this case, it was necessary that the burner burn from 1½ to 7 lb. of sulphur per hour at a rate that could be controlled by the volume of water being treated. At a given setting the variation in burning rate had to be less than 10 per cent. The burner must not require any more operating labor than the usual methods of feeding chemicals and it was necessary that it operate for 16 hours each night without any attention. It was to obtain a burner having these specifications that this new burner was built, or rather that this modification of an old type burner was built.

It appeared that the simplest and most logical method of controlling the burning rate would be to control the amount of air supplied the burner and that the simplest type burner both from the standpoint of operation and construction was a pan type burner. Consequently the work was concentrated on developing a pan burner that would have a definite relation between the amount of air supplied and the amount of sulphur burned. The two factors preventing the accomplishment of this were that ordinary sulphur contains a very small percentage of organic matter and this organic matter accumulates as a carbonaceous scum on the surface of the burning sulphur gradually extinguishing the fire; and that the addition of a fresh charge of sulphur to the burning pan disrupts the burning rate for several hours. In the newly developed burner the accumu-

Figs. 1 and 2—Diagram of the new sulphur burner and a completed burner equipped for steam heating

lation of the carbonaceous scum is prevented by operating the burner at a higher rate than previously had been considered normal for this type burner. When the burning rate is greater than 2 lb. per hour per square foot of burning surface, the carbonaceous scum is burned off and causes no trouble. A special sulphur feeding device was developed that will feed melted sulphur to the burner in a manner that will not disturb the burning surface and a constant level can be maintained in the burning pan.

The construction of the sulphur feeder is diagrammed in Fig. 1. Solid sulphur is added to the hopper *A* where it is melted by the heat supplied in steam jacket *B*. If a source of steam is not readily available, electric heating elements *C* are provided. Whenever it is desired to fill the feeder *D*, the valve *E* between the burner and feeder is closed and the valve *F* between the feeder and hopper is opened. Molten sulphur runs down from the hopper filling the feeder. Then the valve positions are reversed; valve *F* is closed and valve *E* is opened. Sulphur runs down the feed pipe *G* until the liquid sulphur level *H* in the burner gets up to the end of small pipe *J*. At this point the flow of sulphur stops, since the end of the feed pipe is sealed and no more sulphur can run into the burner until the level drops enough to permit gas to bubble up the feed pipe and displace sulphur in the feeder until the end of the pipe *J* is again sealed with liquid sulphur. The principle of this feeder is used in a common type of water feeder for chickens. The feeder maintains the level in the burner without any appreciable variation. The particular arrangement with the main feed pipe terminating near the bottom of the burner and a smaller pipe at the surface of the sulphur, is used instead of one large pipe ending at the surface of the sulphur, because it is desired to add the sulphur below the level of the burning sulphur so that the burning surface will not be disturbed. On account of the relative size of the two pipes all the sulphur goes down the main feed pipe. The feeder is made large enough so that filling is necessary only once a day.

The actual operation of the burner is simple. Air enters at one side *K* and is deflected over the burning surface by a baffle *L*. The burner gas leaves at the opposite side *M*. With the sulphur feeder operating a definite relation is maintained between the amount of air supplied and the amount of sulphur burned. Curves for three different size burners are shown in Figs. 3, 4 and 5. These burners operate from 1½ to 7 lb. per hour, 7 to 30 lb. per hour, and 20 to 75 lb. per hour. Within these limits the maximum variation obtained in burning rate is 10 per cent. They will actually operate at rates above or below the limits given but outside these limits the variation in burning rate is likely to be somewhat more than 10 per cent.

By changing some of the factors affecting the burning rate the burning characteristics of a burner may be varied considerably. The dotted line in Fig. 4 shows the effect of insulating the top half of the burner with ½ in. of asbestos cement. Also by changing the dimensions the burning characteristics may be changed. With the same burning area, increasing the length of the burner in the direction of the air flow while decreasing it in the other direction results in a more concentrated gas being produced. The two smaller size burners are 22 in. in the direction of the air flow and produce approximately the same concentration of sulphur dioxide. The same dimension of the larger size burner has been increased to 38 in. and the concentration of gas produced has been increased approximately proportionally.

The amount of sulphur sublimed unburned by these burners is small. While no accurate measurements of this have been made, no trouble has been experienced with a burner in continuous operation for over a year.

The heat for the jacket may be supplied from any convenient source. If steam at a pressure greater than 25 lb. per square inch gage is available it may be used. The burner shown in Fig. 1 is designed to operate where steam is not available and has a self-contained heating unit. The jacket is filled approximately half full of water. One or two electric heating units of the common hot water heater type are installed as illustrated. These heaters are controlled by a pressure switch to maintain a pressure of about 30 lb. per square inch gage on the jacket. A high flash point oil may be used in a similar manner as a heat transfer

Fig. 3—Characteristic curves of 1.1-sq. ft. burner

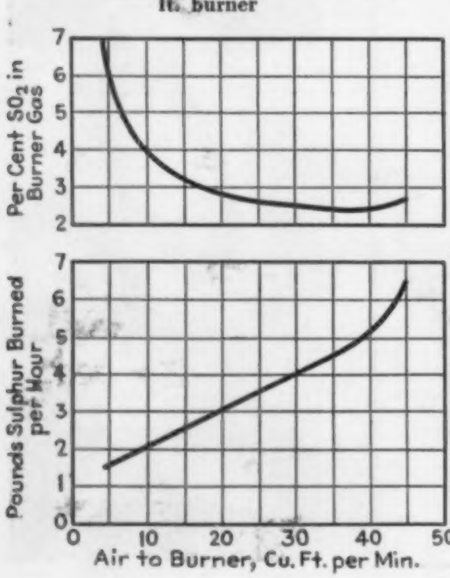


Fig. 4—Characteristic curves of 3.4-sq. ft. burner

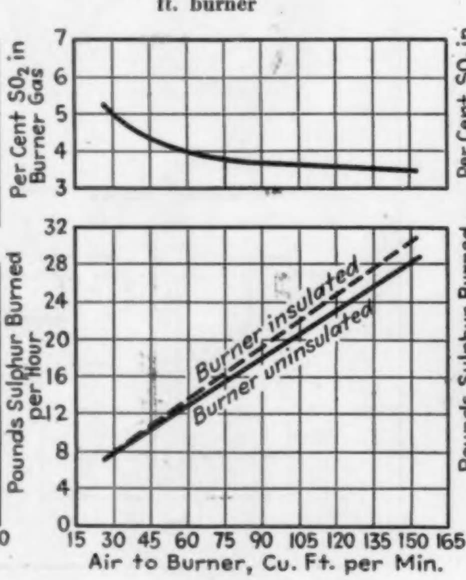
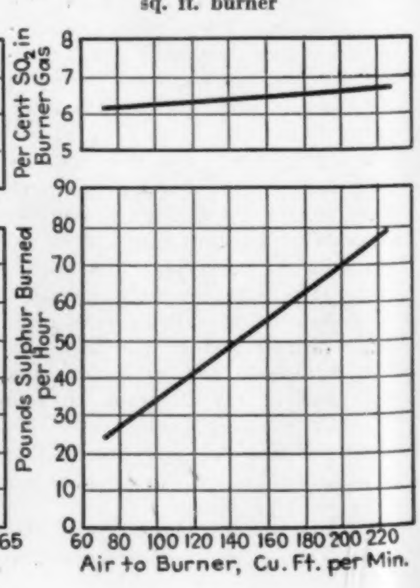


Fig. 5—Characteristic curves of 10.0-sq. ft. burner



medium. On account of the small amount of heat required to melt sulphur practically the only heat that must be supplied is that necessary to compensate for the heat loss from the jacket. With 1½ in. of magnesia block insulation on the jacket the total amount of heat that must be supplied to the 7 to 30-lb. burner is equivalent to 0.4 kw. when sulphur is being burned and 1.3 kw. when no sulphur is being burned. The heat requirements of the other size burners are about the same.

The design of the equipment permits easy removal of the sulphur valves and other parts for cleaning and reworking. The first of these burners was built with welded steel construction using standard pipe sections wherever possible. This is satisfactory for the hopper, feeder, and jacket but cast iron burner boxes will undoubtedly have a longer life. A burner box made of ½-in. boiler plate has been in service continuously for 16 months, however, and it appears that it will last several years longer. A gage glass of the flat type used in steam boilers is placed in one side of the lower half of the burner box. This permits observation of the fire and sulphur level. Although it is partially in the fire, one such glass has been in continuous use for a 16-month period without deterioration.

That the feeder will operate equally well with pressure or vacuum on the burner is a distinct advantage. The burner gas may be discharged with sufficient pressure to force it through the sulphur dioxide absorbing apparatus. If the burner is operated under pressure a relatively inexpensive air blower may be used instead of a more expensive acid resistant blower that is necessary if the burner is operated under induced draft.

A burner of this type has been used continuously since March 1938 in treating 1,000,000 gal. of boiler feedwater a day in the company's plant at Hoskins Mound, Texas.*

In order that sulphur users may benefit from the advantages of this design when small quantities of sulphur are to be burned, the Freeport Sulphur Co. will gladly make complete information on the design and construction available upon application to the company's development department in New York.

* The equipment consists of an air blower, an air meter, an air regulating valve, a sulphur burner, and a lead-lined, coke-packed absorber. A small portion of the total water is bypassed through the absorber to absorb the sulphur dioxide from the burner gas. The water being treated is softened water that contains an excess of alkalinity. Usually about 30 parts per million of sulphur dioxide is added to this water and the pH is reduced from 10.7 to 10.4. In the 30 minutes that elapse between the time this sulphur dioxide is added and the water enters the boiler feedwater heaters, 32 per cent of the added sulphur dioxide is oxizided to sulphate under usual conditions. To increase the amount oxidized, a metallic catalyst must be used. When 0.025 parts per million of copper is added to the water under the same conditions that accompany 32 per cent oxidation, 80 per cent oxidation is obtained. In operation, the amount of sulphur dioxide and copper sulphate added is regulated so that enough of the sulphur dioxide added will be oxidized to give the desired sulphate-alkalinity ratio and at the same time maintain a residual of sodium sulphite in the boiler blowdown, thus insuring a completely deaerated boiler water. The amount of copper sulphate used is less than 1 lb. of copper sulphate crystals per day. The whole system operates for months without any attention except to fill the hopper and feeder once each day.

The saving by using this process over using sodium sulphate and sodium sulphite is over $7 per million gallons of water. An equally important consideration when operating high pressure boilers is that the use of sulphur dioxide in this manner causes practically no increase in the dissolved solids in the boiler feed water while the amount of sodium sulphate and sodium sulphite used adds 690 lb. of dissolved solids to each 1,000,000 gal. of water.

LIQUID MIXING

(Continued from page 636)

chemical" bonds) was introduced to account for miscibility and partial miscibility. It was further indicated that the rate of release of this latent work can be influenced in various ways: (1) by an increase in the kinetic energy of the ultimate particles of each component; (2) by an increase in the energy imparted mechanically to these ultimate particles; (3) by an increase in the number of contacts between the particles; or (4) by increasing the area of contact between the phases. For some time it has been generally accepted in other connections that the rate of mixing action can be influenced by variation in temperature and pressure. Lately a new phenomenon has been shown to occur, namely that the increase of surface contact of the phases results in increased solubility, or, in other words, that an increase of surface increases the work that can be accomplished by the latent forces of the system. The concept introduced by the authors was that agitation is a method of increasing the rate of release of the latent work, that is, that the efficient application of correct proportions of direct and indirect shear results in increased rates of solution and actually in slightly increased solubility.

To bring out more fully the significance of these ideas, Table II lists factors involved in obtaining increased rates of solution, increased extent of solution, and also increased reaction rates and increased extents of reaction.

Table II—Physical Means of Influencing Reaction or Mixing Rates

Gas-gas	pressure	temp.	(agit.)
Gas-liquid	pressure	temp.	agit.
Gas-solid	(pressure)	temp.	agit.
Liquid-liquid		temp.	agit.
Liquid-solid		(temp.)	agit.
Solid-solid		(temp.)	agit.

The significance of this table is to bring out the role that agitation plays in chemical processes. Not only is it our purpose to show how agitation aids temperature and pressure, but also to indicate that the energy level of a system can be increased not only by temperature and pressure, but also by means of agitation. It is our contention that the energy state and the energy level of a system are describable by temperature, pressure, and work input in the form of agitation.

As indicated in this table, the effect of pressure on reactions and on solution falls off until, in gas-solid reactions, it must be replaced by agitation. The effect of temperature, in like manner, becomes less important until in the case of liquid-solid reactions it must be replaced in part by agitation. In the case of solid-solid reactions, the effect of temperature may be still less important, while pressure may be completely negligible and must be replaced almost entirely by mechanical agitation. Agitation cannot replace temperature and pressure as completely as temperature and pressure can replace agitation, at the present stage of our mixing equipment development, but in spite of existing limitations of equipment, agitation as a partial replacement for high temperatures and pressures can be utilized with great savings. It is also our belief that agitation in the future will play an increasingly important role on account of technical advances in the field of mixing.

Correction: In the article by S. T. Powell *et al*, on the treatment of water with sulphur compounds (*Chem. & Met.*, August 1939), the tenth line from the bottom of the second column on page 484 should read: ". . . rapidly at pH values of 8.0 to 10.0."

How Long-Tube Evaporator Works

A practical correlation and interpretation from a performance viewpoint of recent researches on the underlying theory of this evaporator shows the probable mechanism of what happens in its operation.

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THE long-tube, natural-circulation evaporator has received relatively little study. In the last few years, there have been some publications that have discussed specific phases of the theory of this evaporator, but a complete analysis of its performance is so difficult that publications so far have been more for the purpose of getting information on record than to assist in an understanding of this evaporator. Although much work remains to be done, a sufficient advance has now been made to warrant a preliminary discussion from a more or less qualitative point of view.

The type of evaporator under discussion is one that has tubes with a ratio of length to diameter of 150 to 200. There has been no uniformity in the actual sizes used, but, possibly, a tube 1.25 in. I.D. and 15 to 20 ft. long is typical. It will be assumed that the reader is familiar with the general features of construction. It is generally stated in the literature that these evaporators are operated with a low liquor level, but actually the conception of a static liquor level has no significance in such evaporators.

Consider an evaporator tube of the proportions mentioned above, surrounded by heating steam, and that this tube is supplied at the bottom with feed at a temperature below the temperature of the steam and below the temperature of the vapor head. Common practice employs such a small rate of feed that the velocity of the non-boiling liquid in the tube is almost always in the viscous range. Imagine that the apparent Δt (i.e., the difference between the saturation temperature of the heating steam and the saturation temperature corresponding to the pressure in the vapor head) is very small. As the feed rises through the tube, the coefficient of heat transfer to it is very small. The limiting case will be one in which the total heat input is not sufficient to heat the liquid to the boiling point, and, therefore, the evaporator acts as a tubular heater. The liquid will simply overflow from the tubes on the top tube sheet in a steady stream. This may be called *Stage 1.*

If, now, the apparent Δt is increased, a time will come when the liquid begins to simmer slightly. A few bubbles of steam will form in the liquid as it overflows the tube, but this stage, which may be called *Stage 2*, is of no theoretical or practical significance.

It would naturally be expected that if the Δt continued to increase, this simmering would pass into stronger boiling and that the boiling would gradually work down into the tube from the top. Such is not the case. If such a tube were watched during the process of slowly raising the Δt, the first indications of a change would be the sudden ejection of a considerable amount of non-boiling liquid followed by a puff of steam, and then the tube would be perfectly quiet until another slug is ejected. At low values of Δt, these slugs of liquid are large, the puff of steam following is small, and the time between them is long. With increasing Δt, the slugs become smaller, more frequent, and more steam accompanies each one. This is *Stage 3* and, according to our present understanding of the evaporator, is an extremely important stage.

On still further increasing the Δt, the successive periods between slugs become so short that they can no longer be carried up through the tube as such. Around the top of each tube will be seen a crown of rather large slow-moving drops of liquid, which rise only a very short distance and then drop back onto the tube sheet; while the core of the tube is occupied by a jet of steam that apparently contains some entrained liquid as spray. This, *Stage 4*, is the range in which many evaporators operate in practice. The crown of large drops represents a relatively thick layer of water travelling up the tube wall at a relatively low speed. An examination of a glass evaporator shows that this layer often runs back on itself, producing rings of liquid along the tube which, in Stage 3, would coalesce to solid slugs of liquid but which, in this stage, increase to a certain point and are then blown back up the tube.

The limiting condition comes when the heat flux is so large that no appreciable slow-moving layer of liquid remains on the tube wall. This is *Stage 5;* and the crown of slow-moving large drops around the top of the tube has disappeared. There remains only a stream of steam containing a suspension of fine particles of liquid travelling at a very high rate of speed.

It would be interesting to know how each of these stages affects the rate of heat transfer during boiling, but that is dependent on a measurement of heat transfer in the boiling section only. Overall measurements on the whole tube merely give a weighted mean of the low coefficients in the non-boiling section and the

high coefficients in the boiling section.

The author and his co-workers applied to this problem the method of the axial travelling thermocouple developed first by Logan and improved by Boarts in their studies of the forced-circulation evaporator. The type of curve obtained will depend on the rate of feed, the physical characteristics of the liquid, the difference in temperature between the feed and the boiling liquid, the working temperature drop, the tube proportions, and possibly other factors. Many hundred such curves are now available in the records of this investigation, and a few sample ones are reproduced in Fig. 1.

On the basis of these curves, the boiling and non-boiling sections of the tube can be separated on the assumption that the point of maximum temperature indicates the point at which boiling begins. It is assumed that all of the liquid (whose rate of input and inlet temperatures are known) is heated to the maximum temperature indicated by the traverse, and the heat needed for this is computed. This is subtracted from the total amount of heat transmitted through the tube, and the remainder gives the total amount of heat transmitted to the boiling section. The boundary between the two sections is known from the position of the maximum on the curve; the mean temperature in each section may be determined by integrating the temperature curve and thus, the boiling and non-boiling coefficients can be calculated separately.

When these heat-transfer coefficients in the boiling section were studied, it was found that, everything else being equal, the heat-transfer coefficient is greater at smaller temperature drops. This does not appear directly in the work that has so far been published; but a comparison of published work with a very large amount of unpublished work has shown this quite clearly. It is necessary to make comparisons on the basis of strictly comparable conditions, especially comparable boiling lengths. A sample set of data from the paper of Brooks is as follows:

Run	L_B	U_B	Δt
L-23	14.0	972	6.5
L-6	14.2	903	7.5
L-13	14.9	740	10.3
L-18	14.6	551	16.6

Research publications to be made in the near future will develop this idea quantitatively.

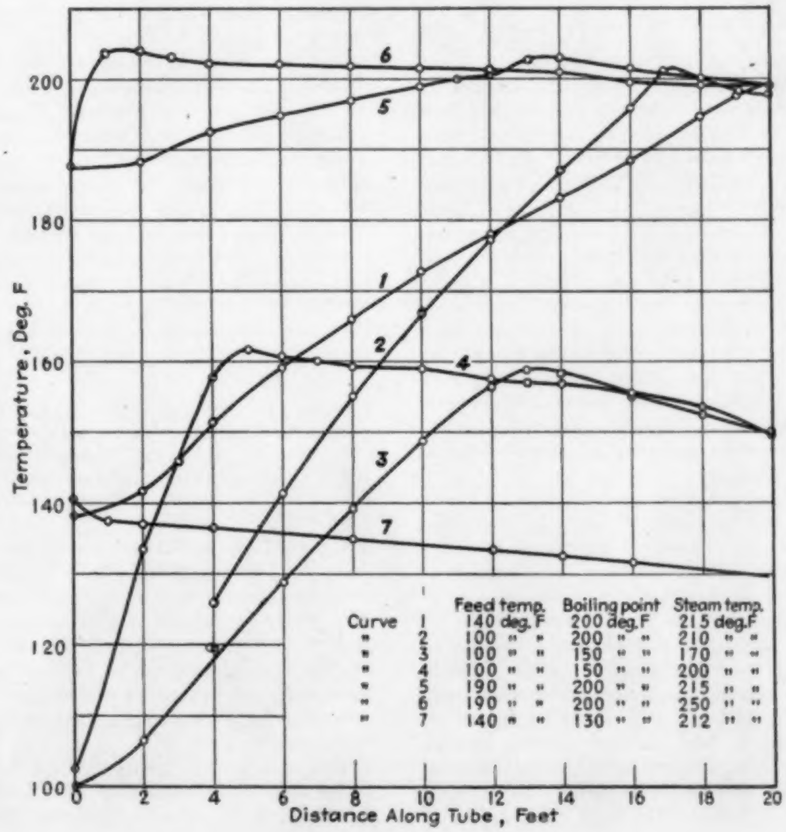
At first sight, it would appear that higher temperature drops (i.e., larger volumes of vapor and higher vapor velocities) should scrub the tube wall thoroughly and, therefore, give higher coefficients. A possible explanation for the reverse condition is found in a paper by Partridge on the mechanism of the formation of boiler scale. He showed, by examining the surface on which steam bubbles were forming, that the area under the bubble is dry. Conceivably, with high temperature drops and large heat fluxes, the proportion of the surface so dried may be sufficient to account for the decrease in the heat-transfer coefficients. By this line of argument and a comparison of the stages in the behavior in the tube mentioned above, it would appear that it is more important to drown the heating surface with relatively large amounts of liquid than to depend on high velocities to wipe off the steam bubbles.

Unfortunately, observations have not yet gone far enough to permit exact statements as to the ranges in which each of the four stages of operation mentioned above occurs. Neither can they be determined by an inspection of the temperature traverses of Fig. 1. However, it is known that, beginning with large temperature drops (in the order of 50 deg. F. or more), as the temperature drop decreases the performance goes back through stages 5, 4 and 3, in that order; and the heat-transfer coefficient in the boiling section rises.

In applying this in practice, it must be remembered that, as the temperature drop is decreased, the length of the tube necessary to carry out the heating, increases, and the length of the boiling section decreases. This may be carried so far that the decrease in the length of the boiling section more than off-sets the increase in the boiling coefficient. All these relationships are matters that must be subject to future investigations.

It is evidently desirable to correlate the usual heat-transfer data with a visual observation of what is going on in the tube. For this purpose, the Swenson Evaporator Company plans to build, in the laboratory in the Engineering Research Department at the University of Michigan, a glass experimental evaporator in which this correlation can be studied. Future papers will be published as fast as the information is accumulated.

Fig. 1. Curves obtained in studies of long-tube evaporators



Chemical Engineer's BOOKSHELF

Handbooks, Directories and Guides

Handbook of Chemistry. 3rd edition. Compiled and edited by *N. A. Lange*. Published by Handbook Publishers, Inc., Sandusky, Ohio. 1850 pages. Price $6.

IN THE FIELD of chemistry this handbook probably serves a function comparable to that of the unabridged dictionary in the field of literature. It is a compilation including such fundamental information as atomic weights and numbers, periodic table, tables of inorganic and organic compounds including formulas, physical properties, trade names, etc. for a total of approximately 6,500 chemicals. There is a mathematical appendix and a section on materials of construction. This one volume library serves the dual purpose of a space saver and a time saver inasmuch as one would have to search through many tomes indeed to find all of the information compiled herein. The index is extremely comprehensive and we note especially that the editor has been most meticulous about cross references.

Handbook of Chemistry and Physics. 23rd Edition. Edited by *Charles D. Hodgman*. Published by Chemical Rubber Publishing Co., Cleveland, Ohio. 2,239 pages. Price $6.

THE ANNUAL REVISION of the Handbook of Chemistry and Physics is again off the press, and we welcome it because of a considerable number of improvements and additions. There are about 400 pages of entirely new composition and expansion and revision of many more. The new composition is made up of additional tables including melting and boiling point indexes of organic compounds, elliptical integrals, free energy and potentials of electrochemical reactions.

As usual, the book includes comprehensive fundamental data in the allied fields of chemistry, physics and mathematics. There are five main divisions. The first 300 pages comprise the mathematical tables. The second part covers the properties and physical constants of the elements, inorganic, metal organic and organic compounds, oils, resins minerals, plastics, etc. Common names of chemicals are included in this section. The third division gives general chemical tables and specific gravities and properties of matter. The fourth gives physical tables on heat, sound, electricity, light, etc., and the fifth includes quantities and units, conversion tables and other miscellaneous information not elsewhere classified.

One great improvement in the format of this edition is the increased page size allowing for larger margins so that when the book lies open all the material on the spread is plainly visible. The index appears to be quite complete and the cross references adequate.

Chemical Formulary. Edited by *H. Bennett*. Published by Chemical Publishing Co., New York, N. Y. 638 pages. Price $6.

Reviewed by *John R. M. Klotz*

THE GROUND COVERED in this edition is more comprehensive than that of any previous one and I feel that the editor has done an excellent job in this compilation. In a ready reference and brief form he has placed before layman as well as before the specialist much information that might otherwise necessitate a great deal of time to ferret out. Since the material contained in this volume is so comprehensive, it seems to me that instructors of Industrial Chemistry might do well to have extra copies available for outside reading for their students, especially for those students who have a thorough understanding of chemical theory, but who are groping for some better understanding of its application to industry. From the standpoint of the student and the industrialist I consider this work a constribution to our science.

Rayon and Staple Fiber Handbook. By *Herbert R. Mauersberger* and *E. W. K. Schwartz*. Third edition. Published by Rayon Handbook Co., New York, N. Y. 832 pages. Price $4.50.

THIS IS THE THIRD edition of an already well-known Handbook, which has been completely revised, brought up-to-date and enlarged because of continued growth of the filament rayon industry, the tremendous progress of rayon staple fiber and spun rayons as well as the increased activity in research and technical knowledge.

Two entirely new chapters have been added in this edition entitled "The Manufacture of Rayon Staple Fiber and Spun Rayon Yarns" and a complete "Glossary of Rayon Terms." There are a number of special contributions from experts in fields involving spun rayon, such as textile economics, the viscose process, cellulose-acetate process, cuprammonium process, testing, knitting, drycleaning, laundering and home and consumer problems.

In the dyeing, printing and finishing chapters, new developments such as inhibiting acetate fading, package dyeing of acetate, application of synthetic resins, non-slip and new anti-crease finishes are discussed extensively. A complete list of textile chemical auxiliaries has also been added. Printing with resins and lacquers is dealt with extensively and with the advent of staple fiber and spun rayon fabrics such processes as napping, decating and shearing are included.

All the newer fibers such as protein fibers, and the new synthetic fibers such as "Nylon" and "Vinyon" and glass fiber have been merely touched upon presumably because their commercial development has not as yet been sufficiently developed.

The contents of the book are logically arranged and include a complete subject index and a glossary of rayon terms used in both American and foreign literatures.

Chemicals of Commerce. By *Foster Dee Snell* and *Cornelia T. Snell*. Published by D. Van Nostrand Co., Inc., New York, N. Y. 552 pages. Price $5.

PARTICULAR EMPHASIS is placed on chemicals of great trade importance. Many products are omitted, some briefly mentioned, but those which enjoy commercial importance are dealt with rather extensively. The book is arranged by classes, closely related substances appearing in the same chapter. To quote the authors, the book is to serve "as a quick source of summarized information about products as a class." While details about individual substances are, of necessity, frequently omitted, the salient facts about almost every type of commercial material are included. Although, as previously mentioned, the compounds are arranged in classes there is a very detailed alphabetical index at the end of the book which will enable the reader to locate any product quickly.

No actual prices are quoted. However, the relative costs of certain widely used

commercial chemicals are included. Practical and scientific information is combined in such a way as to make the book appeal to the technical man as well as to the salesman or manufacturer.

PRICE POLICIES

INDUSTRIAL PRICE POLICIES AND ECONOMIC PROGRESS. By *Edwin G. Nourse* and *Horace B. Drury*. Published by The Brookings Institution, Washington, D. C. 314 pages. Price, $2.50.

Reviewed by *R. S. McBride*

CHEMICAL and other process industry executives are going to be confronted with many new price problems due to war conditions abroad. Uncle Sam will try to control many of these policies by law. But this will not relieve the individual management and operating engineer from adjusting his own firm's business with the rapidly moving currents by which the company is influenced.

Planning a sound price policy for any chemical or equipment item demands a good knowledge of fundamental industry economics. This book is a splendid text for guidance in all such matters. It is written by economists but in such clear language and with so many industrial explanations as to be really useful to the chemical engineer and process industry manager.

To be sure, not all of the price philosophy presented is applicable to chemical situations. But the fundamental laws influencing prices and price making are readily translatable by the intelligent reader into a form useful in his own business. The examples chosen in the book are excellent. The presentation is simple and clear, but accurate and dependable. Those who need to be brought up-to-date on process industry economics, and most of us do, will find the volume valuable. Even the thought that the New Deal assisted by the war is trying to repeal the laws of economics is not adequate excuse for not studying these important fundamentals of business relationship.

COMBATING CORROSION IN INDUSTRIAL PROCESS PIPING. By *L. G. Vande Bogart*. Published by the Crane Co., Chicago, Ill. May 1939. 103 pages. Price, $3.

Reviewed by *James A. Lee*

THIS BOOK HAS BEEN PREPARED primarily as a guide for those who use, maintain or recommend piping materials to resist corrosion. In Part I the material included has been selected rather arbitrarily in order to provide a background upon which to base explanations of the problems which are most frequently encountered. Part II is devoted to metals, alloys and other structural materials that are used for handling corrosive fluids. In general this section is devoted to: (1) The tendencies of the metals to corrode in solutions of varying pH value either in the presence or absence of oxidizing agents; (2) The general tendencies to form natural protective coatings in various environments. Part III is built around a long list of the most common chemicals. An attempt is made to give the readers some general idea of the methods by which they are made, the applications for which they are used and their corrosive tendencies.

At the end of the book is a list of corrosive fluids arranged in alphabetical order, together with condensed recommendations based largely on a choice of value materials.

PETROLEUM FACTS AND FIGURES. 6th edition. Published by the American Petroleum Institute, New York, N. Y. 192 pages. Price $1.

THIS NEW EDITION brings up to date all data in the 1937 edition and adds approximtely 50 new or completely revised tables. As far as possible all usable new data available up to August 1939 are included. The 215 tables are distributed under seven chapter headings: utilization, production, refining, transportation, marketing, prices and taxation. Because of the arrangement, the book is in large measure self indexing. In addition to the tabular material, important petroleum industry lists are given in an appendix: directors, officers and complete roster of the American Petroleum Institute; list of government petroleum statistical and regulatory agencies; a directory of petroleum and allied associations; a directory of petroleum-company house organs and a list of publications of the American Petroleum Institute.

This edition has been published by the Department of Public Relations of the American Petroleum Institute and covers operations of the petroleum industry in all its branches.

RECENT BOOKS AND PAMPHLETS

Fluid Flow Measurement by Head Type Metering Elements. By F. C. Stewart and J. S. Doolittle. Published by Instruments Publishing Co., Pittsburgh, Pa. 16pp. Price 50c. This pamphlet, which originally appeared as an article in the magazine *Instruments* is an exceptionally clear and concise presentation of the theory of fluid flow as interpreted by dimensional analysis and as applied to pressure drop in closed conduits and to fluid flow measurements by ventures, orifices and petot tubes. Chapter I presents the theory, Chapter II the application to flow problems and Chapter III the application to flow measurements. Numerous valuable references and worked-out problems are included.

Brown's Directory of American Gas Companies, 1939 Edition. Published by Robbins Publishing Co., New York, N. Y. 706 pages. Price $25. This is the annual volume which gives the only complete index of American public utility companies selling manufactured and natural gas, and the holding companies that own and control the local enterprises. Any process industry having dealings with the gas industry will, of course, require the volume.

Standard Methods for the Sampling and Analyzing of Aluminum and Certain Aluminum Alloys. 2nd Edition. Released by Aluminum Research Institute, Chicago, Ill. The original purpose of this pamphlet was to give methods of analyzing the rapidly increasing number of complex aluminum alloys, including secondary aluminum, containing wide assortments of elements, among which were many of the rare elements. The first edition was designed to meet these needs. Of the thirteen methods which the first edition contained, five remain the same and four additional methods have been added. Remarkable strides have been made since 1932 in the analytical technique, used by consumers as well as by certain manufacturing specialists of Aluminum Ingot, in the necessary degree of accuracy, simplified procedure, minimum testing, and moderate cost. Improvements developed in various laboratories have been freely passed on for trial to others, and the second edition of these "Methods" is the result.

Scientific and Industrial Research. Report for the Year 1937-8. Published by His Majesty's Stationery Office, British Library of Information, New York, N. Y. Price 90c. The summary of the Advisory Council for Scientific and Industrial Research includes brief notes from all the divisions including such branches as chemical research, water pollution, toxic gases in industry, fuel, rubber and lubrication. Each section concludes with a summary of current literature on the subject covered.

A Bibliography of Unit Operations of Chemical Engineering. By C. C. Furnas, E. E. Litkenhous, G. H. Montillion, R. A. Ragatz, R. C. Ernst. Published by the Department of Chemical Engineering of the University of Louisville, Louisville, Kentucky. The more important references in the unit operations of chemical engineering, covering the last ten years, are included in this bibliography. The work is up to date including references as late as the latter part of 1938. The literature cited comes from all parts of the world and includes references to periodicals of practically every country in Europe, many in Asia and the United States. The subjects covered include crystallization, diffusion, distillation, drying, evaporation, extraction, filtration, fluid flow, gas absorption, heat transmission, materials handling, mixing, size reduction and size separation.

Union List of Scientific Periodicals in the Chemical Libraries. Second Edition. Published by Special Libraries Association, New York, N. Y. Price $2.50. This second edition of 1,000 titles, representing 69 libraries, as compared to 49 in the first edition published in 1935, includes the libraries of many large industrial concerns, universities and privately maintained institutions. The form of entry is the same as in the Union List of Serials. The list not only gives the place wherein periodicals may be located, but also just which issues are to be found in any specific library. The periodicals listed are representative of the biological, chemical, mechanical, medical and physical publications.

Vapor Charts and Special Tables for Turbine Calculations. By Frank O. Ellenwood and Charles O. Mackey. Published by John Wiley & Sons, New York, N. Y. 43pp. Price $2.50. This is a new and extended edition of the "Steam Charts" published by Ellenwood in 1914, which were used extensively by designing engineers some years ago. These charts have specific volume as the abscissa and enthalpy as the ordinate. They, therefore, give the user one more steam property than does the Mollier chart included in Deenan and Keyes. The lines on the charts are clear and sharp and well spaced for accurate interpolation.

Baking Powders. By Simon Mendelsohn. Published by Chemical Publishing Co., Inc., New York, N. Y. 178 pages. Price $4. The development, chemistry, manufacture and evaluation of chemical leavening agents are covered, from the production as well as the theoretical viewpoint. Each phase of baking powder manufacture is treated at some length, the author supplementing the text with photographs of equipment, microphotographs of ingredients, charts and a flow sheet. The biggest value of the book is in its material on the technical evaluation of baking powders.

Burning of Coal in Down-Draft Ceramic Kilns and Burning Characteristics of Some Ohio Coals, by W. E. Rice and C. R. Austin. Bureau of Mines, Technical Paper 598; 10 cents.

Regional Research Laboratories, Department of Agriculture. Report of a survey relative to present research and that proposed for four Regional Research Laboratories. Senate Document No. 65, 76th Congress, 1st session; 50 cents.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

A List of American Doctoral Dissertations Printed in 1937. Library of Congress; 50 cents.

Statistics of Income for 1936, Part 2, Compiled from Corporation Income and Excess-Profits Tax Returns and Personal Holding Company Returns. Bureau of Internal Revenue; 30 cents.

Agreements of Gas, Coke, and Chemical Workers (District Fifty, U. M. W.), by Fred Joiner. Bureau of Labor Statistics, Serial No. R. 927.

Foreign Markets for American Medicinal Products, by C. C. Concannon and E. A. Chapman. Bureau of Foreign and Domestic Commerce Trade Promotion Series No. 193; 15 cents.

Production Employment, and Productivity in 59 Manufacturing Industries, Parts I, II, and III, by Harry Magdoff, Irving H. Siegel, and Milton B. Davis. Works Progress Administration, National Research Project Report No. S-1. Available only from Works Progress Administration, 1734 New York Avenue, Washington, D. C.

Abbreviations Used in the Department of Agriculture for Titles of Publications, by Carolyn Whitlock. Department of Agriculture, Miscellaneous Publication No. 337; 30 cents.

Japanese Beetle Regulations. The Bureau of Entomology and Plant Quarantine has recently issued administrative instructions to inspectors on the treatment of nursery products, fruits, vegetables, and soil, for the Japanese beetle, known as B.E.P.Q. 499. In addition, an amendment to the Japanese beetle quarantine regulations has been promulgated known as B.E.P.Q.—Q.48. Both mimeographed announcements are available from Bureau of Entomology & Plant Quarantine.

Wood Plastics as Developed at the Forest Products Laboratory and Their Future Importance, by E. C. Sherrard, Edward Beglinger, and J. P. Hohf. Forest Products Laboratory, Madison, Wisconsin; mimeographed.

Electrical Moisture Meters for Wood, by M. E. Dunlap. Forest Products Laboratory, Madison, Wisconsin; mimeographed.

What Can Be Done to Make Paint Maintenance More Successful, by F. L. Browne. Forest Products Laboratory, Madison, Wisconsin; mimeographed.

Contributions of Synthetic Resins to Improvement of Plywood Properties, by Don Brouse. Forest Products Laboratory, Madison, Wisconsin; mimeographed.

Bureau of Mines Analyzes the Reduction in the Tariff on Zinc. Bureau of Mines, Mineral Market Series No. 755; mimeographed.

Coordination of Safety and Employment, by G. W. Grove. Bureau of Mines, Information Circular 7079; mimeographed.

Employment and Accidents at Copper Mines in the United States, 1938. Bureau of Mines, H.H.S. No. 263; mimeographed.

Marketing Talc, Pyrophyllite, and Ground Soapstone, by Bertrand L. Johnson. Bureau of Mines, Information Circular 7080; mimeographed.

Mineral Wool, by J. R. Thoenen. Bureau of Mines, Information Circular 6984R; mimeographed.

Bureau of Mines Midget Impinger, by H. H. Schrenk and Florence L. Feicht. Bureau of Mines, Information Circular 7076; mimeographed.

Relative Air Dustiness During Cycle of Operations at Mount Weather Testing Adit, by John A. Johnson and Wing G. Agnew. Bureau of Mines, Report of Investigations 3453; mimeographed.

A Washability Study of the Black Creek Coal Bed at Yolande No. 6, Rockcastle, Ala. Bureau of Mines, Report of Investigations 3450; mimeographed.

Classification Chart of Typical Coals of the United States, by A. C. Fieldner, W. A. Selvig, and W. H. Frederic. Bureau of Mines, Report of Investigations 3296R; mimeographed.

Cooperative Fuel Research Motor-Gasoline Survey, Winter 1938-39, by E. C. Lane. Bureau of Mines, Report of Investigations 3455; mimeographed.

Minerals Yearbook 1939. Bureau of Mines; $2.00 (cloth).

Greater Uses for Dairy Byproducts, by E. O. Whittier. Article in July, 1939 issue of The Agricultural Situation, Department of Agriculture; 5 cents.

Animal and Vegetable Fats and Oils, Production, Consumption, Imports, Exports and Stocks, Quarterly for Calendar Years 1934 to 1938. Bureau of the Census; 10 cents.

Census Summaries. Statistics are given for various economic and technical aspects of business in the form of releases from the 1937 Census of Manufactures, as follows: Wage Earners and Wages in Establishments Classified According to Number of Wage Earners; Personnel Other Than Wage Earners and Salaries Paid; Cost of Materials, Containers, Fuel, Purchased Electric Energy, and Contract Work. Bureau of the Census; processed.

The Iron and Steel Industries of Europe, by Charles Will Wright. Bureau of Mines, Economic Paper 19; 20 cents.

Prosphate Resources of the United States. Extract on "Fertilizers and Agriculture" from hearings before Joint Committee to Investigate the Adequacy and Use of Phosphate Resources of the United States. Available only from National Fertilizer Association, Investment Building, Washington, D. C.

Survey of Experiences in Profit Sharing and Possibilities of Incentive Taxation. Senate Report No. 610, 76th Congress, 1st session; 30 cents.

Technology, Employment, and Output Per Man in Petroleum and Natural-Gas Production, by O. E. Kiessling et al. Works Progress Administration, National Research Project Report No. E-10. Available only from Works Progress Administration, 1734 New York Avenue, N. W., Washington, D. C.

Rubber Industry of the United States, 1839-1939, by P. W. Barker. Bureau of Foreign & Domestic Commerce, Trade Promotion Series No. 197; 10 cents.

World Chemical Developments in 1938, by C. C. Concannon and A. H. Swift. Bureau of Foreign & Domestic Commerce, Trade Promotion Series No. 195; 25 cents.

Industrial Market Data Handbook, by O. C. Holleran. Contains figures for 1935 on industrial production, employment, value of products, cost of material, fuel and power, and output per wage earner by counties, and cities of more than 10,000 population. Bureau of Foreign & Domestic Commerce, Domestic Commerce Series 107; $2.50.

The Anti-Shrink Treatment of Wood with Synthetic Resin-Forming Materials and Its Application in Making Superior Plywood, by A. J. Stamm and R. M. Seborg. Forest Products Laboratory, Madison, Wisconsin; mimeographed.

Washing, Cleaning, and Polishing Materials, by F. W. Smither. National Bureau of Standards, Circular 424; 15 cents.

The Significance of Dust Counts, by J. M. Dallavalle. Public Health Service, Reprint No. 2083; 5 cents.

Silicosis and Lead Poisoning Among Pottery Workers (West Virginia). Public Health Service, Reprint No. 2057; 5 cents.

Silicosis Prevention — Dust Control in Foundries. Division of Labor Standards, Department of Labor, unnumbered pamphlet; 10 cents.

Instructions for the Operation and Maintenance of Distilling Plants. Bureau of Engineering, Navy Department; 25 cents.

Compression-Ignition Engine Performance with Undoped and Doped Fuel Oils and Alcohol Mixtures, by Charles S. Moore and Hampton H. Foster. National Advisory Committee for Aeronautics, Technical Notes No. 707; mimeographed.

The Effect of Continuous Weathering on Light Metal Alloys Used in Aircraft, by Willard Mutchler. National Advisory Committee for Aeronautics, Report No. 663; 15 cents.

Resistance of Transparent Plastics to Impact, by Benjamin M. Axilrod and Gordon M. Kline. National Advisory Committee for Aeronautics, Technical Notes No. 718; mimeographed.

Temperature-Indicating Paints, by F. Penzig. National Advisory Committee for Aeronautics, Technical Memorandum No. 905; mimeographed.

Foreign Directories. Bureau of Foreign & Domestic Commerce, Trade Information Bulletin 841; 10 cents.

Preparing Shipments to British Countries (except Canada), by Robert A. Wakefield. Bureau of Foreign & Domestic Commerce, Trade Promotion Series No. 154 (revised); 25 cents.

Readers' VIEWS and COMMENTS

Student Engineers and Unions

To the Editor of Chem. & Met.:

Sir:—As a young chemical engineer in a large chemical company, the writer has a natural interest in the present possibilities and future opportunities of young engineers.

After observing for a few years the results of corporation-labor union negotiations in several industries, the writer wonders about the exact position occupied by the young industrial technician in an industrial program of union appeasement.

Unionized labor apparently is being rather successful in taking unto itself numerous semi-technical jobs which formerly belonged to technical men and which afforded opportunities for working college-trained technical men into the plant scheme of production.

In one large chemical plant ten foremanships, formerly filled from the straight-time payroll, were recently closed to straight-time men and promises were given the union that the jobs would be filled from the hourly payroll. The jobs were to be filled after consulting the union as to suitability of promotions and seniority would apply in the consideration of applicants. Although these jobs were not necessarily filled by college men previous to the agreement, it is now impossible for the company to give these jobs to college men—unless such men are willing to work in very subordinate positions while acquiring the necessary departmental seniority.

Several years ago many companies thought that the best way to break in young technical men was to start them working in the production departments of the factory. Thus the college man was forced to get his hands dirty, thereby losing his feeling of academic superiority; he had the opportunity to make friends with the workers; and he could learn plant procedure from the operations standpoint. Some companies still prefer to start their new college men this way if possible. At present, however, production department break-in probably is impossible in those companies which have signed union agreements because seniority requirements hinder job shifting and promotions must ordinarily be made from "the ranks." How then can companies with a union contract in force train their college men?

Some companies push college men through the analytical laboratories and then make them assistant supervisors.

Many companies, intentionally or otherwise, have turned to the field of research for training purposes. "Research" when so used may mean anything from pure research through technical trouble shooting to a mere hanging around the operating departments. The results of such "research" vary considerably in work accomplished for the company and in knowledge gained by the technician. These results depend in part upon the characteristics of the man, the amount and quality of supervision possible from his supervisor (possibly already overworked), and the amount of information to be gained from vaguely hostile union operators. Even assuming that all college men are composite Dale Carnegies, Albert Einsteins and Henry Fords, and learn rapidly, this system has one defect — only a few men can be trained at one time. This is due to the limited amount of supervision usually available and to the limited amount of research which ordinarily may be done around a production department which is operating normally.

If, in the future, better times or war scares speed up industry, how will an adequate number of college-trained men become available? The writer believes that companies should meet the situation squarely. A deal should be made with the unions whereby a certain percentage of operating foremanships (say 30–35 per cent) could be filled from the salaried ranks without seniority consideration and that salaried men in training in the departments should receive full cooperation from union employees. The union should understand that an aggresive company needs well-trained men and that men trained in the operating departments should make more understanding superiors than those otherwise trained.

Possibly industry is waiting for the next presidential election or the investigation of the NLRB before asking the unions for any concessions. Labor leaders however, will relinquish their powers only when compelled by circumstances to do so. Regardless of elections or investigations it is probable that union influence — if it declines — will wane slowly. In the meantime college men must be trained. Industry cannot wait forever.

Although industrialists are prone to keep silent regarding union difficulties, a frank discussion of student training in a technical magazine should be of value to executives and student engineers alike. It seems certain that the younger readers of *Chem. & Met.* would welcome some articles by personnel authorities discussing "Union Recognition and the Student Engineer" or related subjects.

J. N. B.

To the Editor of Chem. & Met.:

Sir:—I have read with much interest your statement, "America has a potash industry capable of covering all requirements if need should arise." We have been working for several years on the development of an economical refining process for the mineral *polyhalite*, believing that the domestic supply of potassium sulphate was far less than the demand. The citrus and tobacco growers find it highly inadvisable to use the muriate and hence, large quantities of the sulphate are imported. These imports were valued at $2,851,881 in 1937 and $1,910,819 in 1938. If the development of a source of potassium sulphate equal to the amount imported is not yet an accomplished fact, the inference of your above quoted statement might well serve to retard such development.

W. A. Cunningham

Chemical Engineer
Univ. Station
Austin, Tex.

Errata

In the chemical data sheets of our Facts and Figures of the American Chemical Industry, the Koppers Co., No. 214, should have been listed as a manufacturer of benzol, creosote oil, cresols, naphthalene, phenol and toluol. No. 215 was used instead due to a mechanical error on our part.

The Virginia-Carolina Chemical Corp., No. 449 was omitted by error from the list of manufacturers of sodium phosphate and superphosphates.

We wish to extend our apologies to Phillips & Jacobs of Philadelphia, Pa. for not including them in our list of manufacturers of chemicals and related products. They are producers of silver nitrate as well as gold chloride.

Process Equipment NEWS

Machinery, Materials and Products

Convertible Ball Mill

A NOVEL FEATURE recently introduced by the Denver Equipment Co., 1400 Seventeenth St., Denver, Colo., is a type of construction applied to its ball mills which makes it possible to lengthen these mills at any time by the simple addition of an extra section of shell, and extra liners. This convertibility is accomplished by building each shell section with a flange at each end. Thus, a short ball mill will be made of a single shell section with ends attached to the two flanges. To double the length of this mill, it is only necessary to insert another shell section of the same length, together with the necessary liners, between the old section and the end.

New Screen Cloth

A NEW TYPE of screen cloth, made of piano wire, has been introduced recently by the Jeffrey Manufacturing Co., Columbus, Ohio. This new product is unusual in that the screen contains no cross wires. The wires are stressed to such a high tension that they develop a resonance, having the peculiar property of passing undersized particles much more rapidly than the conventional type of cloth, according to the manufacturer. In other words, the claim is that the new piano wire screen has a much greater capacity and longer life, with almost complete freedom from blinding.

Owing to the great tension placed on the wires, it is necessary that the screen sash be especially constructed. At present, this cloth is made in meshes from [illegible] in. to 120 mesh, and can be furnished in stainless steel if desired.

Controllable Capacity Pump

ALDRICH PUMP CO., Allentown, Pa., is offering the newly developed Aldrich-Groff "Powr-Savr" pump, which is of the variable-stroke, vertical, triplex type designed for such applications as liquid process charging, boiler feeding, steam desuperheating, hydraulic press pressure, and similar uses. This pump is stated to afford positive control of delivery without requiring any change in motor speed. Almost any free-flowing liquid can be handled at pressures ranging from 200 to 15,000 lb. per sq. in. The entire running gear is totally inclosed, and all bearing points are positively lubricated. Control of the delivery rate may be accomplished either manually, or automatically according to the indications of various sorts of instruments, and control may be from a remote point.

The principle of the new pump is indicated in the accompanying cross-sectional drawing. The triplex pump section proper does not differ greatly in principle from the conventional triplex pump design. The variable stroke feature, however, is decidedly novel. The three plungers are all driven from the single crankshaft by individual mechanisms, but since all are driven identically the following description will apply to only one.

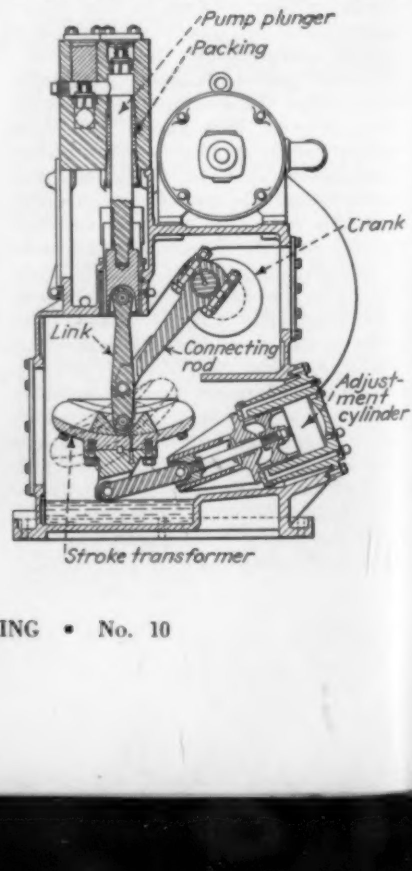
The pump crank, driven through herringbone reduction gearing from a constant speed motor, causes reciprocation of the connecting rod. This rod is pivoted to a link and serves to oscillate the link about its pivoted connection to the pump plunger crosshead. At the bottom of the link and connected to it by a pivot is a guide block which slides back and forth in a smooth curved track in the "stroke transformer." The radius of curvature of this track corresponds to the length between pivot centers of the link.

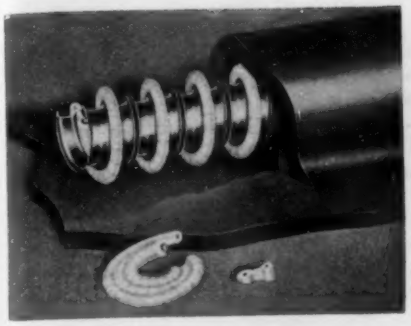
In the position shown for the stroke transformer, oscillation of the link causes no movement of the piston. However, when the piston in the adjustment cylinder, through its connecting link, tilts the stroke transformer upward toward the right, the effect is to produce reciprocating movement of the plunger upon oscillation of the link. Since the stroke transformer can be tipped through any angle from zero to a maximum, therefore movement of the pump plunger can be controlled between zero and the maximum capacity of the pump.

As previously mentioned, various methods, both manual and automatic, can be used for adjusting the delivery of this pump. For manual control at the pump, a handwheel and mechanical means are provided instead of the adjustment cylinder. Hydraulic adjustment, as indicated in the drawing, is used for remote manual control and for automatic control. In regard to the pump proper, special features include discharge valves located directly above the plungers, and inlet valves at one side of the cylinder, to streamline design prevents entrance of The upright design prevents entrance of air into the pumping chambers via the stuffing boxes, because the plunger packing is sealed by the liquid. Outside packing permits close observation and quick adjustment of the stuffing boxes when necessary.

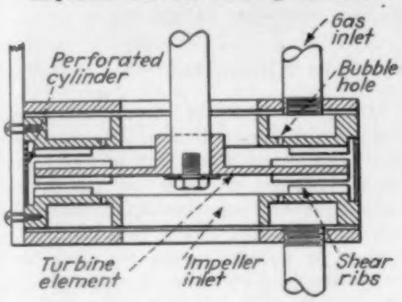
New piano wire screen cloth on vibrating screen

Cross-section of new Aldrich-Groff pump





Improved electric heating element



Cross-section of new injection type mixer

Electric Heat Unit

PATTERSON "Flasheat" element is the name of a new electric heating element announced by the Patterson Foundry & Machine Co., East Liverpool, Ohio. The new element is claimed to have more rapid heat-up, more heat concentration per unit area, higher efficiency, unusual ruggedness, longer life and a higher degree of immunity from mechanical destruction. It is designed for easy replacement without removal of the insulating jacket from the kettle or other receptacle on which it is used. It need not be preformed to fit the shape of the kettle. The new units are now standard equipment on Patterson electrically heated kettles and are also available for use on other sorts of equipment.

Injection Type Mixer

A NEW TYPE of agitator adapted to gas-liquid mixing, as well as liquid-liquid mixing problems requiring especially uniform distribution, has been announced by the Hendrick Mfg. Co., Carbondale, Pa. The unit, which is shown in the accompanying drawing, consists of a turbine element which is overhung and underhung by hollow stator elements. The latter are perforated on their rotor-faced surfaces, these perforations serving as ejection holes for the material which is fed to the stator hollows by the indicated feed pipes. The stator members also bear on their rotor-faced surfaces shear ribs which cooperate with the ribs on the rotor element to shear the charge.

Liquid to be treated is brought to the impeller through the upper and lower openings in the stator by the pumping action of the rotor. This liquid is then passed between stator and rotor so as to exert a spatula action on the gas or liquid discharged from the bubble holes. The distribution of the mixed materials is then enhanced by the shearing of the charge as it passes between rotor and stator. Improved results on low-viscosity charges are attained by surrounding the unit with a delivery-muffling cage.

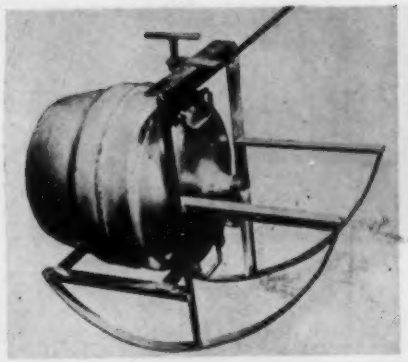
It is claimed by the manufacturer that the mixing action of the new unit in gas-liquid reactions such as hydrogenations and oxidations has invariably reduced reaction time drastically or else made operation at a lower pressure possible. Among other suggested uses are flue-gas absorption, gas scrubbing, sulphonations, nitrations, lube-oil acid treating, etc.

Vertical disk mill for blending

New vibrating sifter

Dry Blending System

A NEW USE for a type of revolving vertical disk mill made by Sprout, Waldron & Co., Muncy, Pa., has recently been announced by that company. The company points out that two or more finely ground ingredients, if commingled by rolling them back and forth over a sheet of paper, will yield an uneven mixture as evidenced by smoothing out with a spatula. However, if the mixed material is thoroughly turned over and rubbed with a spatula, the materials soon form a product in which no one material retains its original identity or color. It is claimed that this necessary rubbing and blending action has hitherto been possible only in ball mills of considerable size and expense. It has been found that the company's vertical disk mill, equipped with intermeshing, spike-tooth, segmental, removable disks, gives the necessary rubbing action and effects complete mixing and blending in a much shorter time and at greatly reduced power requirements as compared with other equipment. An advantage of this equipment is ready cleaning. Sizes range from 20 to 36 in. diameter of the disk and various types of drive are available.



Pourer for aluminum carboys

Safety Carboy Pourer

WORKING in cooperation with the Aluminum Co. of America, Lewis-Shepard Sales Corp., 245 Walnut St., Watertown, Mass., has developed a new one-man safety carboy pourer for use specifically with the new all-aluminum carboys. As shown in the accompanying illustration, operation of the new carboy pourer is simple. With a carboy resting on its base, the pourer is placed over the top and clamped securely by means of a threaded handle just below the shoulder. Then an easy pull on the handle brings the carboy over into pouring position, resting on a broad rocker space.

New Vibrating Sifter

SLIDING SURFACES and exposed moving parts have been eliminated in a new vibrating screen sifter for granular and pulverized materials which has been announced by the Read Machinery Co., York, Pa. A vibrating screen extending the full length and width of the sifter is operated from a standard motor with a guarded V-belt drive. Material is sifted to a polished vibrating discharge surface with an outlet at one end. Use of a short stroke allows discharge of material through a short flexible sleeve. Screens are readily removed for cleaning and arrangements can be furnished for continuous feed and dustless operations, if desired. Any commercial metal or alloy can be used in the construction of this screen.

New Control Devices

A NOVEL TYPE of control for gas heated equipment, and another for electric heating, have been announced recently by Wheelco Instruments Co., 1929 South Halsted St., Chicago, Ill. The gas control is a self-actuated temperature control valve with a remote-bulb temperature element designed to operate either as a throttling or as an on-and-off control depending upon the circumstances. Normally as the temperature element is heated or cooled within the throttling range, a double-seated valve is in operation, proportioning the gas to the demand. However, should the temperature

New aluminum stage for maintenance

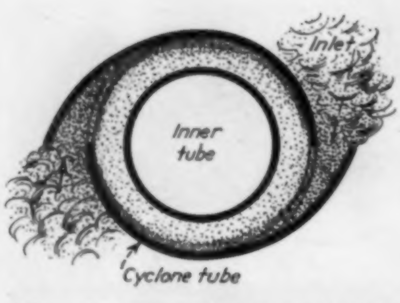
approach the upper limit of the throttling range where the tendency for blowback would become imminent, the valve will close completely. As soon as the temperature has dropped enough to permit it, the valve opens wide until the temperature approaches the control point, when it again reverts to throttling action.

The company's new electrical control, known as the Rheotrol is a manual control device for use instead of a rheostat in the circuit of an electric furnace or other electrically heated equipment. Where a rheostat accomplishes control through resistance, with the consequent loss of power as heat, the Rheotrol permits the full current to flow for a part of each minute, turning the current off automatically during the balance of the cycle. The device can be adjusted for any desired ratio of "on" to "off" time from 0 to 100 per cent. Rotating cams control the operation of switches so as to give the desired cycle. For example, if set at 30 per cent of full input, the current is switched on for 18 seconds and off for 42 seconds in each minute. Using Micro switches the rating is 10 amp., 110 v. If equipped with a mercury switch, 35 amp. at 110 or 220 v. may be carried.

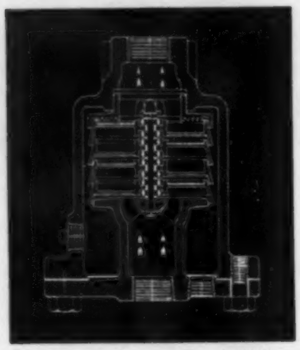
Aluminum Stage

A RECENT DEVELOPMENT of the Aluminum Ladder Co., 239 Adams St., Tarentum, Pa., is an aluminum stage for maintenance work, bridging across tanks and similar uses, which is made in lengths from 8 to 25 ft. and widths from 12 to 24 in. Extremely light and much stronger than wood, the new stages are made in various weights to meet various demands. The type illustrated weighs only 118 lb. for a size of 25 ft. x 24 in., yet it will support six men totalling over 1,000 lb. in weight with scarcely perceptible deflection. The walking surface of the stage is of wood and all other parts of aluminum.

This company has also introduced a new roller-type portable conveyor made of 61 S. P. Alcoa aluminum. The conveyor is mounted on steel ball-bearing wheels fitted on an eccentric axle at each end of the conveyor. When the wheels



Schematic cross section of double-inlet cyclone tube



Cross section of Aridifier moisture eliminator

are in the "down" position, the conveyor is easily rolled from place to place. When they are lifted, the conveyor rests firmly on the floor. Only one or two people are needed to change the location of the conveyor owing to its light weight.

Tubular Dust Collector

A SPECIAL MODIFICATION of its Thermix Multicyclone has recently been introduced by the Prat-Daniel Corp., Port Chester, N. Y., under the name of Tubular Dust Collector. This design, intended particularly for limited space requirements, employs as the separating medium what is, in effect, a group of double-inlet cyclones of relatively small diameter, usually about 6 in. These cyclones are without inlet arms and without a cone for the lower part. Each cyclone consists of a cylindrical tube equipped with two slots in the upper half. Each slot has a directional vane on the exterior of the tube to guide dust-laden gas into the tube in a tangential direction. The lower half of the tube extends into a dust hopper through a tube sheet. The gas enters an inlet plenum chamber and passes through the slots in the tube, rotating around a smaller central tube. The central tube extends to a point somewhat below the bottom of the slot and upward to a tube sheet which forms the bottom of the outlet duct.

Capacity of the equipment may be raised by shortening the inner tube, or efficiency increased by lengthening it. A relatively short tube gives a collection efficiency, according to the manufacturer, of about 80 per cent on fly ash.

The new design is capable of many variations. For example, it may be installed vertically, or horizontally, or at an angle. The entire dust collector is surrounded by its inlet duct and dust hopper, resulting in economy of space and weight.

The accompanying illustration is a diagram of a single cyclone tube in cross-section. It should be noted that a complete collector consists of a multiplicity of such tubes, all fed from the same plenum chamber and all discharging dust into the same hopper and cleaned gas into the same outlet.

Moisture Eliminator

LOGAN ENGINEERING CO., Lawrence and Lamon Ave., Chicago, Ill., has recently introduced a new type of separator for the removal of water, oil and other foreign matter from compressed air and other gases. This device, the Aridifier, consists of a heavy casing with inlet at the bottom and outlet at the top, within which is a series of rotors mounted so as to be free to rotate on stainless steel ball bearings. The rotors are provided with vanes and openings through which the air must pass. The vanes are arranged similar to those of a wind mill, and each alternate rotor has its vanes inclined in the opposite direction so as to revolve opposite to the preceding rotor and thus prevent the air from developing a whirling action. As the air passes through, entrained material impinges on the vanes of the rapidly revolving rotors and is thrown outward, running down the inner wall of the casing and collecting in its lower part for draining manually or through a trap. Nickel cast iron is used for the casing, and an aluminum alloy for the rotors. Owing to the large open area of the device and the lightness of the rotors, it is claimed that there is no perceptible drop in gas pressure.

Equipment Briefs

LABORATORY FURNITURE CO., Long Island City, N. Y., announces that it is now prepared to supply laboratory sinks made in a new chemical porcelain of extremely dense, non-porous construction. This porcelainware, which was briefly described on page 280 of our May 1939 issue and the manufacture of which was described in detail on pages 512-16 of our September 1939 issue, is that made by the Lapp Insulator Co. of LeRoy, N. Y. It will be recalled that the ware has previously been described as completely vitrefied, dense, homogeneous and uniformly strong. Dye penetration tests show complete non-absorption for the unvitrefied body. The new sinks made from this material are of one-piece construction, without joints. Edges and corners are well-rounded for easy cleaning.

THE AUTOMATIC continuous gas detector and alarm for hydrogen sulphide

and other gases described on page 332 of our June 1938 issue is now available from its manufacturer, B. O. Bushnell, 541 North Kings Road, Los Angeles, Calif., in the form of an automatic analyzer which, in connection with a strip chart recorder, gives quantitative readings in parts per million by volume, down to 1 p.p.m. In its simpler form the instrument consists of a single unit to which the gas to be detected must be brought. Or, the instrument may be equipped with a power-driven suction fan for bringing the gas from distances up to 50 ft. By use of a gathering system, several different samples may be alternately checked at regular intervals. The instrument is recommended for use only as a detector and alarm, however, when operating with the gathering system. Although regularly equipped with an indicating meter, a strip-chart potentiometer recorder may be used when records are necessary.

For direct determination of carbon monoxide concentration in the atmosphere, Mine Safety Appliances Co., Pittsburgh, Pa., has introduced a new portable, hand-operated carbon monoxide indicator capable of measuring concentrations from 0 to 0.15 per cent CO. Readings can be estimated to one part per 100,000. The instrument, which is readily carried and handled by one man, weighs 16 lb. complete.

A new line of self-contained space thermostats featuring the previously described Hydraulic Action principle has been announced by Julien P. Friez & Sons, Division of Bendix Aviation Corp., Baltimore, Md. A load carrrying capacity of 25 amp. at 120 v., or 15 amp. at 240 v., is possible without relays. A coiled fluid tube on top of the case serves as the temperature element and is said to assure unusual sensitivity.

Improved protection against chlorine is said to be the feature of the new approved chlorine mask with GML cannister which has recently been announced by the Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa. Bearing Bureau of Mines approval No. 1422, the mask uses a new cannister developed solely for chlorine service which is said to furnish protection over a considerable longer period than previous types of cannister. The outfit is stated to be light in weight and comfortable to wear with features making for speedy application.

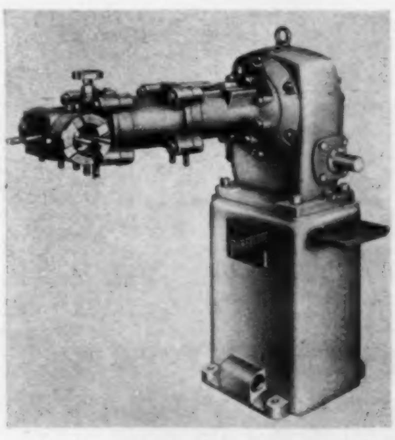
A line of miniature pressure regulators for gas flows up to 50 cu.ft. per hour has been designed for high-pressure service by Hoke, Inc., 122 Fifth Ave., New York, N. Y. These pressure regulators, known as Series 500, are built in two types, one for delivery pressures up to 550 lb. and the other for pressures up to about 1,000 lb. per sq. in. This equipment is available for all non-corrosive gases. Non-standard regulators are built for higher pressures or larger volumes. These regulators are intended for semi-plant and laboratory use and are stated to be easy to use and adjust. A relief valve is provided in all cases for protection of the instrument.

Lincoln Electric Co., Cleveland, Ohio, has introduced a new material known as Surfaceweld A, a hard-surfacing powder for application with the carbon arc. This material is a fine-grained alloy powder which can be applied to give a smooth, dense, hard and abrasion-resisting surface, and can be applied in a very thin layer if desired. Properly applied, the coating has a hardness of approximately 54 Rockwell C. The alloy is stated to maintain its hardness at high temperatures and to resist scaling. Annealing will not soften it. Corrosion resistance of the material is stated to compare favorably with stainless steel.

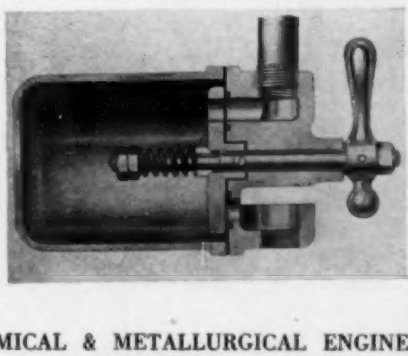
Resin Extruding Machine

Continuous extrusion of resin compounds is said to be successfully accomplished through the use of the new Royle plastic extruding machine, made by John Royle & Son, Straight and Essex Sts., Paterson, N. J. This new machine uses feed screws and die heads substantially the same as those long used for rubber. The machine consists essentially of a cylinder through which a specially designed conveyor screw carries material, fed into one end of the cylinder, to and through a die at the opposite end. The screw masticates and compresses the compound and the product emerges in a continuous length and in a shape determined by the die. The machine is used to make rods, tubes and channels; to insulate wire and to cover hose and rollers. It is also used to remove particles of foreign matter from stock by straining them through wire mesh or cloth.

Perfected resin extruding machine



Cross-section of moisture trap for gas line



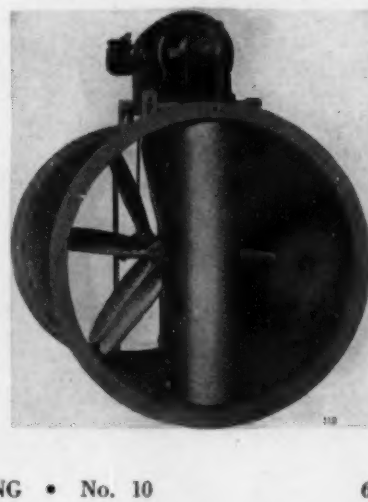
Condensate Trap

A positively sealed moisture trap for removing small quantities of moisture from gas lines operating at pressures of 1 lb. per sq. in. or less has been developed by the Pacific Flush-Tank Co., 4241 Ravenswood Ave., Chicago, Ill. Moisture from the gas line drains into the trap which is placed at the lowest point in the line. Periodically, the collected moisture is drained off by manually turning the operating handle a half turn, in which position the gas line is disconnected from the trap. After drainage, a half turn in the opposite direction cuts the gas line in again for continued operation. The trap is furnished with 1-in. pipe thread connections.

Propeller-Type Blower

A new propeller-type blower for use in a duct, with the motor entirely outside the gas stream, has been announced by the Hartzell Propeller Fan Co., Piqua, Ohio. This design is intended for moving air at high temperatures or where acids or other elements might damage the motor. The motor is mounted on top of the blower housing on a hinged platform which is adjustable for adjustment of the belt tension. The V-belt used for power transmission can be replaced from outside the housing. Within the duct the belt is protected by means of a steel guard. The Charavay Tear-Drop propellers used are claimed to give high air deliveries against heavy back pressure. The standard range is from 18- to 48-in. propellers, 12 sizes being available.

New duct mounted propeller-type blower



MANUFACTURERS' LATEST PUBLICATIONS

Air Heaters. Despatch Oven Co., Minneapolis, Minn.—Bulletin 74—8 pages completely describing this company's indirect gas- and oil-fired air heaters for ovens, dryers and space heating.

Autoclaves. Blaw-Knox Co., Blaw-Knox Division, Pittsburgh, Pa.—Bulletin 1685—16 pages on this company's process autoclaves, illustrating various types and discussing such features as heating in considerable detail.

Blowers. Roots-Connersville Blower Corp., Connersville, Ind.—Bulletin 120-B11—20 pages describing this company's centrifugal single- and multi-stage centrifugal blowers and exhausters, giving pressure-volume curves and information regarding operating characteristics.

Boilers. Henry Vogt Machine Co., Louisville, Ky.—16-page booklet describing this company's forged-steel, sectional-header-type boilers, showing construction details and giving drawings of typical installations.

Bolts. Pittsburgh Screw and Bolt Corp., 2719 Preble Ave., N. S., Pittsburgh, Pa.—Catalog 39—96-page catalog on bolts, nuts, rivets and rods, with detailed price lists.

Buildings. The Austin Co., Cleveland, Ohio—"Multistory or Single Story—Which?" Fifth edition of this company's booklet describing relative advantages and disadvantages of these two forms of factory construction.

Cements. The Atlas Mineral Products Co. of Pennsylvania, Mertztown, Pa.—Folder K-1—4 pages describing this company's new Korez acid-, water- and oil-proof cement, a synthetic resin material for jointing acid-proof brick.

Centrifugals. American Tool & Machine Co., Hyde Park, Mass.—4-page leaflet describing new dischargers for basket centrifugals recently developed by this company.

Chemicals. Carbide & Carbon Chemicals Corp., 30 East 42d St., New York City—Chemical Group Folder No. 9—6-page leaflet describing and giving physical property information on a number of the newer commercially available organic acids and anhydrides containing four to eight carbon atoms.

Cleaning. Homestead Valve Mfg. Co., Hypressure Jenny Division, Coraopolis, Pa.—Leaflet 17A4—Describes two new models of this company's Hypressure Jenny steam vapor spray cleaning machine, together with earlier models of this equipment for industrial cleaning of equipment, floors, building interiors and exteriors, and parts.

Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis. — Bulletin B-6004 — 24 pages on this company's Superior McCully crushers, with detailed construction information and parts list; Bulletin B-6013, 20 pages with engineering data on construction and use of the Vari-Pitch Speed Changer; B-6029, 28 pages with engineering data on Texrope drives and a variety of types and sizes of electric motors.

Filters. Bird Machine Co., South Walpole, Mass.—Bulletin 5—4 pages on a number of applications of this company's centrifugal filters and batch centrifugals, giving actual performance data.

Filters. The Selas Co., Philadelphia, Pa.—Bulletin 906—Leaflet describing a line of porcelain filter crucibles now being offered for collection of precipitates.

Filtration. Oliver United Filters, Inc., 33 West 42d St., New York City—Bulletin 209—4-page leaflet describing this company's Precoat filter and a typical installation of this equipment.

Gas Generators. The Wellman Engineering Co., Cleveland, Ohio—Publications as follows: Bulletin 97, 16 pages on this company's Wellman-Galusha Clean-Gas Generator with detailed description; No. 98, 4 pages on clean gas from breeze coke; No. 99, 4 pages on making gases for special atmospheres.

Gaskets. Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill.—Celluloid marker for marking and outlining gasket sizes on sheet packing, eliminating use of dividers and necessity of referring to gasket tables. The device carries all necessary information for marking gasket sizes.

Grinders. Prater Pulverizer Co., 1801–55th Ave., Chicago, Ill.—8-page bulletin describing this company's new dual screen grinder for high production on chemicals and other industrial materials.

Heat Exchangers. Griscom Russell Co., 285 Madison Ave., New York City— Bulletin 1612—12 pages describing this company's Twin G-Fin heat exchanger section and the applications of this type of extended surface exchanger.

Instruments. The Brown Instrument Co., Philadelphia, Pa.—Booklet 29-31—18 pages on this company's boiler room instruments with particular reference to CO_2 meters, pyrometers, flowmeters, level meters, thermometers and pressure gages.

Instruments. The Foxboro Co., Foxboro, Mass. — Bulletin 184-3 — 31-page bulletin describing this company's Rotax two-position electric controllers with supplementary information on signalling accessories, measuring systems, external relays, control valves, etc. Also Bulletin 148-5, 24 pages on this company's dial type thermometers with complete description of four standard types.

Instruments. H-B Instrument Co., 2518 North Broad St., Philadelphia, Pa.—Blue Book Part 5—24-page catalog listing this company's full line of engraved stem laboratory thermometers and streamlined hydrometers for a wide variety of uses. A feature is the classification of the instruments by manufacturing uses.

Instruments. Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia, Pa.—Catalog N-33D—16 pages on potentiometer-type optical pyrometers. This is stated to be the first time that the potentiometer method has been applied to a pyrometer of the optical type. Also Technical Publication E-94(1), 12 pages on the Electro-Chemograph, a recording device which automatically inks curves from which analyses can be determined. The method uses the dropping mercury electrode principle.

Instruments. C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.—Bulletin 1206—Leaflet briefly describing this company's new bomb for determining gum stability of gasoline.

Lighting. Wiremold Co., Hartford, Conn.—8-page folder describing this company's fluorescent lighting systems with information on equipment and typical applications.

Metals and Alloys. International Nickel Co., 67 Wall St., New York City—Bulletin T-6—16 pages of technical data, tables and illustrations dealing with the resistance of nickel and nickel alloys to corrosion by caustics.

Motors. U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles, Calif.—Form 1048—4-page folder describing in detail this company's new Lubriflush type of motor bearings designed to insure thorough bearing lubrication and sludge elimination.

Platinum. Baker & Co., 113 Astor St., Newark, N. J.—16 pages on the use of platinum and platinum-clad metals for chemical plant equipment, with information on physical properties and on use of platinum and palladium as catalysts; also 24-page bibliography of U. S. and German patents on palladium as a catalyst.

Power Transmission. W. A. Jones Foundry & Machine Co., 4401 Roosevelt Road, Chicago, Ill.—Bulletin 75—16 pages on a new line of worm-helical speed reducers for vertical shafts, with detailed descriptions, dimensional and performance data, together with other engineering information.

Power Transmission. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia, Pa.—Book 1574—40 pages on this company's P.I.V. variable speed transmissions, with details on construction, sizes and accessories.

Power Transmission. Rockwood Mfg. Co., 1801 English Ave., Indianapolis, Ind.—Booklet 861—16-page booklet describing and listing prices on this company's pivoted motor bases, with detailed description of various styles and applications.

Power Transmission. The Whitney Chain & Mfg. Co., Hartford, Conn.—Catalog V-135—64 pages of engineering data, dimensions, horsepower ratings and other information on silent chain and sprockets.

Pumps. Peerless Pump Div., Food Machinery Corp., 301 West Avenue 26, Los Angeles, Calif.—Catalog 127A—64 pages on this company's full line of water lubricated turbine pumps, oil-lubricated turbine pumps, power pumps, and high-lift deepwell pumps. Descriptions are extremely detailed and particularly well presented by color, folded inserts and hinged partial-page flaps. Many hydraulic engineering data are included.

Refractories. The Ironton Fire Brick Co., Ironton, Ohio—4-page leaflet on No-joint, a plastic firebrick for boiler settings, linings, etc.

Refrigeration. Carrier Corp., Syracuse, N. Y.—Bulletins CR-131 and CR-133—4-page leaflets describing respectively air-cooled, and water-cooled, condensing units in ½ and ¾ hp. sizes.

Safety Equipment. Davis Emergency Equipment Co., 55 Van Dam St., New York City—New handbook type catalog on this company's industrial first-aid supplies covering kits, dressings, treatments, splints and other items required in industrial first-aid work.

Screens. Robbins Conveying Belt Co., 15 Park Row, New York City—Bulletin 107—8-page booklet describing and illustrating applications of this company's vibrating liquid screens for clarifying liquids and dewatering solids.

Shipping Methods. Acme Steel Co., 2840 Archer Ave., Chicago, Ill.—24-page book illustrating the range of this company's products for the steel-strapping of packages, with particular reference to methods useful in export packaging.

Stoneware. United States Stoneware Co., 60 East 42d St., New York City—Bulletin 404—8 pages describing and giving detailed information on principal types of acidproof chemical stoneware mixing and storage equipment including tanks, jars, pots and trays, made by this company.

Tile Conduit. American District Steam Co., North Tonawanda, N. Y.—Bulletin 35-67B—12 pages on this company's tile conduits for underground steam or hot water lines; also gives information on cast iron conduit and Fiberglas insulation for underground lines.

Waxes. The Beacon Co., 89 Bickford St., Boston, Mass.—12-page booklet entitled "Sixty New Synthetic Waxes," listing 60-odd new synthetic waxes together with their characteristics and general suggested uses.

Welding. Lincoln Electric Co., Cleveland, Ohio—Bulletin 405—16 pages on "101 Welding Ideas for Low-Cost Maintenance," describing largely with pictures methods of maintaining a wide variety of equipment; also bulletin 327A, 4 pages on a 300-amp. diesel-driven Shield-Arc welder.

Your Plant NOTEBOOK

"POINT OF ACTION" NOTE TAKING WITH HAND CARDS

By LEROY R. SMITH
Industrial Chemist
Pasadena, Calif.

Notes taken "at the point of action" are worth much more than notes written from memory some time after the action has passed. This is especially true where accurate readings and measurements, names and addresses, and such data must be recorded.

In one petroleum refinery, where blank shipping tags are provided for labeling samples, the operators have found it convenient to have a few tags in their shirt pockets as they make their rounds, so that thermometer readings, tank gages, etc., may be jotted down as they are taken. Later, back in the office, the notes are entered on the record books and the cards destroyed. In the laboratory of this refinery, where several tests usually are in progress at the same time and readings must be noted in rapid succession, the chemists have found the tags very useful. Errors in reports due to bad memory are practically eliminated.

The shipping tags, measuring about 2½ by 5 in., are convenient because a pack of them can be held easily in the hand while one is writing on them, and because they fit nicely in the shirt or coat pocket. The ordinary 3 by 5 index cards are nearly as satisfactory in size, but the ruling is the wrong way. As a deck of the cards is held in the hand, the natural way to write on them is across the short way.

Hand size cards with the ruling the short way can be had without the necessity of a special printing by having the stationery store cut standard 5 by 8 cards, that are ruled on both sides, into three equal sections. Cards made in this way are about the same size as the shipping tags, and are a great deal better for note taking because of the superior quality of the paper and because of the ruling, which is an aid to rapid writing.

Hand cards have proven themselves more adaptable than the pocket notebook for quick, clean note-taking. Although numerous styles of pocket notebook are in use, there are many places where notes must be taken rapidly or where it is out of the question to try to keep the hands clean, and here the use of hand cards offers a real innovation. For rapidity, a pack of hand cards may be taken from the shirt or coat pocket and held in writing position with but a single motion of one hand; and writing on a pack of cards is much easier than writing in an open notebook held in the hand. For clean notes, consider that a card is used only for a short time, whereas the pocket notebook must be carried around and handled for a long time.

Hand cards have been especially convenient in general chemical engineering and research work where the engineer or chemist, in the course of his day's work, meets a variety of subjects on which he will take notes. By using a separate card for each set of notes, the cards may later be sorted for filing or entering in the permanent records. One particular advantage of a pack of hand cards is that after a card is used it can be placed in the back of the pack, thus always leaving a fresh card on top ready for instant use.

In market survey and sales work hand cards made by cutting up standard 5 by 8 ruled cards have been exceptionally satisfactory prospect cards, using a separate card for each contact. In fact, it has been found that writing on a card while it is held in the hand is inconspicuous enough that the average prospect shows no resentment at the taking of notes during the interview. The prospect cards are permanent records in themselves; and are filed according to territory. Regular 3 by 5 filing boxes may be used; however, it is more convenient to make boxes in which the cards may be filed on end.

Hand cards fit into all phases of industrial work. And by providing a really convenient means for taking notes at the point of action, wherever that action may be, they can be responsible for bringing in data that are accurate and complete.

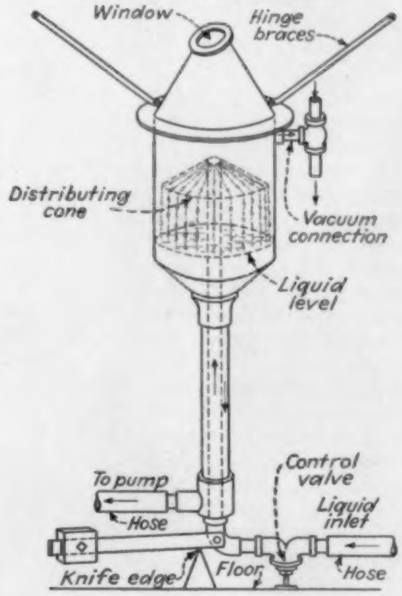
Counterbalanced Floating Tank Used for Accurate Level Control

In the article describing the production of chemical porcelainware which appeared in our September 1939 issue, mention was made of a novel means of level control used by the Lapp Insulator Co., Le Roy, N. Y., in its vacuum deairing tanks for clay slip. The method appears to be equally applicable in many other cases and so is described here in a separate short article.

As is shown in the accompanying sketch, the tank in which the clay slip is evacuated is guided at the top to permit vertical movement and supported at the bottom by means of a counterbalanced lever set on a knife edge. In this way the elevation at which the tank and its contents will balance depends on the weight of the tank contents. Connections to the tank are made by means of flexible hose.

Slip is withdrawn from the tank by a reciprocating pump, and drawn into the tank by the vacuum which is maintained by a water jet ejector, the quantity entering being controlled by a Hills-McCanna diaphragm valve in the inlet pipe. The stem of this valve is attached to the floor, while the body, inserted in the line, rides up and down with the tank. An increase in the weight of material in the tank causes downward movement which decreases the valve opening. A decrease conversely opens the valve. The effect therefore is to maintain an accurate slip level in the tank at all times.

Change in liquid level in this floating tank operates the inlet valve to maintain a constant level



Chemical Engineering NEWS

New Products and Equipment At Chemical Show

Over forty industries, producing chemical materials and equipment, will display their newest products at the Seventeenth Exposition of Chemical Industries. The Exposition, for which nearly 300 exhibitors have already engaged space, will be held at Grand Central Palace, New York, during the week of December 4 to 9.

In addition to the chemical raw materials and manufactured products which the chemical industry will exhibit, there will be many displays devoted to metals and alloys; also to the new synthetic plastics and their versatile applications. Plant machinery and equipment, applicable to each of the unit processes of chemical engineering, also will be shown.

Relating to industrial chemical manufacture, the process equipment to be shown in operation will include units for crushing and grinding, flow of fluids, materials handling, filtration, drying, evaporation, distillation. Other classifications of the Exposition will include packages, containers and packaging machinery; instruments of precision; laboratory equipment and supplies; pumps, piping and steam process accessories; also mill and factory supplies including refractories, cements, coating materials, packing supplies, fire extinguishing systems, factory wash fountains, and safety equipment.

The latest type equipment for drying chemical materials in solid, or powder, form is available for operation with steam, electric, gas, or oil heat. Applications of these units to drying paint pigments, fine chemicals, pharmaceuticals, and rayon will be shown. Direct-heat, rotary dryers will feature large evaporative capacity and high thermal efficiency.

A new drying system on which patents are pending will be exhibited for the first time. This system is said to make unusual use of exhaust gases not only to preheat the wet material as it is fed into the dryer, but also to trap dust. The system is reported to offer high efficiency in handling light-weight, finely-divided materials having high moisture content. Modern centrifugal driers designed for the process industries will feature new units of increased ratings. On the suspended type, improvements emphasize stability at high speed, and increased production. Variable speed drives and facilities for basket removal are emphasized as improvements in the pedestal type centrifugals.

The course of lectures on chemical engineering principles and applications, held regularly in connection with the Exposition, will again be conducted. Prof. W. T. Read, Dean of Chemistry at Rutgers University, will be in charge. Students come from many states to attend these lectures and a number of colleges give credit for student work done during this period. The courses offer a unique setting in which to coordinate theory and practice.

Control of Foreign Exchange Enters Into Present Trading

Control of foreign exchange was not one of the reasons which prompted the President to declare a limited emergency. The President had complete authority to handle foreign exchange before that proclamation was issued. Financial experts say that the exchange situation is much easier to handle under present conditions than was the case when the world was at peace.

In so far as sterling and francs are concerned the speculation has been cut out of them. All private transactions must have government approval. The big surges that came with speculation and movements of refugee capital are gone. Even trade is controlled.

With all that can be done to control trade, it is recognized that the balance soon will turn heavily against the Allies. They will use the production facilities of other countries according to plans under official control.

There is no confusion this time in the handling of exchange and the purchase of foreign goods. Britain and France have been preparing for war for years. Everything was worked out to a nicety in advance. The plan for handling currency and exchange was complete long before the war started and has been perfectly handled since, according to American officials who have been in a position to observe. Neither the British nor the French started at scratch as they did in 1914. Regulation of domestic consumption began with the state of war. The less essential industries were curtailed or closed. The personnel was put on its mettle to find new jobs in essential industry.

Under the plan so smoothly put into effect during September priority in orders for imports is given the dominions, colonies and countries in the sterling and franc areas. This has cushioned the rush of orders that otherwise might have caused rapid and unhealthy prices in this country. Orders placed here, according to the plan, will be handled with due consideration of price levels, which, incidentally, is making it easier for this government to handle the price situation.

Latin American countries were not prepared for the British-French plan of concentrating early purchases in their own colonies. Such buying as may be done in Latin America in no way compensates for the markets cut off by the British blockade. As a result the republics in this hemisphere are being forced to curtail less essential imports as drastically as though they themselves were at war in order to have exchange to buy essential imports. That situation will improve gradually with allied purchases, which are expected to grow steadily larger as the war progresses.

Next Census Report to Give More Complete Data

Secretary of Commerce Harry L. Hopkins has made public the questions to be asked of American business in the 1940 census. In releasing the eleven schedules of questions to be used, Secretary Hopkins declared:

"Formulated after many months of conferences with business groups, the questions are aimed to provide this country with the most comprehensive inventory of its business ever undertaken. In these rapidly changing times it is most important that both business and government have accurate and detailed information on the American business structure.

"Business men have already made valuable contributions to the framing of these questions for the census, and I feel confident they will continue to cooperate by furnishing complete answers to the questions. As in all census undertakings, the law protects those enumerated by keeping all answers confidential. They are available only to sworn census employees and are not available except in broad statistical form to any other agency in or out of Government. The object of the census is to present a picture of business as a whole."

Viscose Increases Staple Rayon Yarn Capacity

Plans for a new unit for production of rayon staple fiber at the Front Royal, Va. plant have been announced by the American Viscose Corp. The unit, with 25,000,000 pounds annual capacity, will give the company a total output of 90,000,000 pounds.

At present the capacity is slightly under 30,000,000, including the Parkersburg, W. Va. unit and the first Nitro unit. The second Nitro unit will start operating next month and will be in full operation by Spring, bringing the total to 65,000,000 pounds at that time.

Institute of Physics Plans Temperature Symposium

A symposium on temperature, its measurement and control in science and industry will be held at the Pennsylvania Hotel, New York, Nov. 2-4. The symposium will be sponsored by the American Institute of Physics with the cooperation of the National Bureau of Standards, the National Research Council, and officers and committees of many technical societies. The program is in charge of representative committees of authorities in various fields, who have arranged for the presentation of more than 100 papers which will be presented in concurrent sessions of selected groups. Persons active in science or engineering are invited to attend the sessions. Chairmen of the symposium committees include: oil industries, Gustav Egloff, Universal Oil Products Co.; food industries, A. W. Ewell, Worcester Polytechnic Institute; instrument manufacturers, C. O. Fairchild, C. J. Tagliabue Mfg. Co.; process industries, John J. Grebe, Dow Chemical Co.; medical and biological sciences, J. D. Hardy, Russel Sage Institute of Pathology; general engineering, H. F. Mullikin, Babcock & Wilcox Co.; ceramic industries, F. H. Norton, Massachusetts Institute of Technology; metals industries, R. B. Sosman, U. S. Steel Corp.; general science, H. T. Wensel, National Bureau of Standards; education, G. B. Wilkes, Massachusetts Institute of Technology; and automotive industries, C. B. Veal, Society of Automotive Engineers.

Lalor Foundation Announces Program for New Awards

The Lalor Foundation has announced the program for its fourth series of fellowship awards, authorizing grants to the total amount of $20,000 for the academic year 1940-41. The individual awards are scheduled to range between $1800 and $2500 or according to the special needs of the candidate.

Six fellowships of the 1939-40 series are being currently administered by the Foundation, which was organized in 1935. The work of the holders of present fellowship awards is in the fields of physical chemistry, biochemistry and biophysics, and the institutions at which the researches are currently being conducted include Oxford University in England and Cornell University, Princeton University, Johns Hopkins University, the Massachusetts Institute of Technology and the Johnson Institute of Biophysics of the University of Pennsylvania in the United States.

The awards in the 1940-41 series will be given for fundamental research work in any field of chemistry. Support for industrial research is not intended. The awards are open to both men and women and for work anywhere in the United States or abroad.

Du Pont To Increase Capacity Of Nylon Plant

E. I. du Pont de Nemours & Co. has announced that prospective demands for nylon necessitate increasing the plant facilities at Seaford. The original plans for the first unit, now in the course of construction, called for nine spinning machines. In keeping with a "balancing out" program recently adopted, the total will be increased to twelve. The executive committee has directed the engineering department to proceed with designs for a second unit at Seaford.

Japan Establishes Control of Caustic Soda Distribution

The Japanese Government has tentatively decided to introduce official measures to control the distribution of caustic soda in order to insure an adequate supply for the munitions and export industries, according to a report from the Acting American commercial attache at Tokyo. Some degree of control has been effected through trade associations since May, 1938, but as the demand for the product is now reported to be in excess of the supply, it has been deemed necessary to institute legal control measures.

Nichols Medal Awarded to Dr. John M. Nelson

The William H. Nichols Medal of the New York Section of the American Chemical Society, has been awarded for 1940 to Dr. John M. Nelson, professor of organic chemistry at Columbia University, "for important contributions to the chemistry of life processes," it is announced by Prof. Louis P. Hammett of Columbia, chairman of the Section.

Professor Nelson has been cited by the medal jury as "an internationally recognized authority on the isolation and purification of naturally occurring enzymes and the quantitative study of their mode of action." Author of seventy-five papers in scientific journals, he has devoted the major portion of his research to determining the characteristics and activities of enzymes, carbohydrates, and valence.

Professor Nelson will receive the medal at a dinner of the New York Section on March 8, at which time he will speak on the various phases of the research in which he has been engaged.

The Nichols Medal was founded in 1902 by the late Dr. William H. Nichols, a charter member of the Society.

Flow Sheets Out of Print

We are sorry to have to advise our readers that 100 Flow Sheets of Process Industries is now out of print. A new edition is being prepared and an announcement will be made as soon as it is released.

Great Britain Places Many Materials under Control

Under Defense of the Realm Regulations, Great Britain through its Minister of Supply has taken steps to exercise government control over many materials. This control will apply both to supplies and prices and will be applied to molasses, industrial alcohol, acetone, acetic acid, butyl alcohol and derivatives, amyl alcohol and derivatives. To carry out the provisions, a department called the "Molasses and Industrial Alcohol Control" has been set up. Trading in any of the materials included will be subject to license, maximum prices, and other government control. Exports of these commodities is prohibited except under license.

The Minister of Supply also has appointed leading industrialists to have charge of materials as follows: aluminum, The Hon. G. Cunliffe; iron and steel, Sir Andrew Duncan; non-ferrous metals, Captain O. Lyttelton; alcohol and molasses, A. V. Board; sulphuric acid, N. Garrod Thomas; sulphate of ammonia, F. C. O. Speyer; other fertilizers, Howard Cunningham; paper, A. Ralph Reed; leather, Dr. E. C. Snow; silk and rayon, E. W. Goodale; wool, Sir Harry Shackleton; flax, Sir Harry Lindsay; hemp, A. M. Landauer; jute, G. Malcolm; timber, Major A. I. Harris.

Oiticica Oil Imports Gain Due to Tung Oil Shortage

United States imports of oiticica oil, a product of Brazil, are increasing rapidly, and if maintained at the present rate should reach approximately 20,000,000 lb. during the current year, according to the Department of Commerce.

Imports during the first eight months of the current year aggregated 12,248,863 lb. compared with 5,300,899 lb. during the whole of 1938 and 3,631,147 lb. in 1937.

Great impetus has been given to the oiticica oil industry by developments in the Orient which have restricted the exportation of tung oil from China and caused its price to rise sharply in world markets. With the rapid rise in the price of tung oil, more oiticica is being used by paint and varnish manufacturers, as formulas suitable for its use are being developed by paint and varnish chemists.

Statistics recently compiled by the Government of Brazil placed the production of oiticica oil in that country at 14,460 metric tons in 1938 compared with 2,198 tons during the preceding year; 6,262 tons in 1936 and only 674 tons in 1935. Production statistics for the current year are not yet available but it is known that 14 plants are now in operation throughout the country, and that plants in the State of Ceara alone have a rated capacity of 55,000 kilograms of oil daily.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

WAR Resources Board members were not wanted in Washington. In plain language of industry, they were "fired" by Mr. Roosevelt. The expressed reason is that continuance now of a war board would sound much too militaristic to be proper for a peace-loving nation. The real reason was that the New Dealers who still influence Mr. Roosevelt very strongly wanted to get these big business men out of town before they got too firm a grasp on the controls which will be needed in war time to coordinate industry and military activity.

The Senators were evidently somewhat disturbed by this action. They passed a resolution which didn't mention the War Resources Board but did ask the Attorney General to advise Congress of the powers the President is supposed to have under the present "limited emergency" proclamation. No one believes that this resolution drafted by Senator Vandenberg was either devoid of politics or unrelated to the New Deal victory over the War Resources Board.

Later the President will undoubtedly establish a new board. He may even reappoint a number of important big business men who worked with Mr. Stettinius so briefly. The New Dealers are not likely to be permanently granted their wish that such agencies as S.E.C., R.F.C., N.L.R.B., A.A.A., and the rest of the alphabet be allowed to run any preparedness program for the President.

Strategic Purchases

Bids are expected October 19 and 20 for three most urgently needed strategic materials. Under customary purchase methods, the Procurement Division of the Treasury has outstanding five important requests for offerings by industry of manganese ore, chrome ore, and tungsten ore. The anticipated purchases of these three minerals will use a large part of the available ten million dollars provided by the last Congress under the stock pile act.

A few days later the first bids for nonmineral strategics will be received. On October 23, offerings of manila fiber for a reserve stock pile will be taken under a similar procedure. Other purchases of minerals and nonminerals to use the total available funds are expected. The Treasury cannot in advance tell just what its schedule of purchasing will be, because until it gets bids it does not know just how much money it wants to allocate for each of the various commodities desired.

The Navy Department is not having such a comfortable time over one of its contemporary efforts to buy tungsten ore. It had a half million dollars of its own money for this purchase and took bids. One of the two offerings was for imported ore at $15.75 per unit. But the domestic producer's offering at $25 per unit was accepted. Sharp criticism of the Navy purchasing policy has resulted, despite the "Buy American" law, under which the taking of the higher bid is being explained. It is apparently more difficult to explain how the purchasing of a stock of ore already above ground in the United States adds to the stock pile when a much larger quantity of ore now in China could have been brought to the U. S. for the same money.

Export Problems

Washington officials who first talked so glibly about new markets available for American enterprise in Latin America and elsewhere are now much less vocal. The numerous serious difficulties involved in reaching these markets and collecting the bills for goods sent there has become evident. The tone is now one of warning against amateur entry into the export trade.

Some of the more conservative folks about the Capital think that some sort of a cafeteria marketing ought to apply to most sales to neutrals as well as to belligerents. Certainly American exporters of chemicals who follow the cash-and-carry or self-service philosophy in their foreign trade are likely to save themselves a good many headaches. This, however, does not mean that Washington does not still hope for plenty of new business in foreign markets for American firms who are in position to pick up the trade of those who can no longer be supplied from Central Europe.

Much less frequently mentioned, but of large importance, is the necessity for American firms to avoid difficulty through getting themselves on the British black list. Firms who continue trading with German nationals or German firms in neutral areas after warning by Britain are likely to be quarantined on the ground that they are unfriendly to that nation. If blacklisted, they cannot have any of Britain's business now or later.

Potash Progress

Washington spokesmen for potash and fertilizer industries are much pleased with the evidence of progress being made in the supply of potash from domestic sources. No shortages are anticipated although some of the export markets which United States producers have been building may be temporarily sacrificed. Even the special requirement of potassium sulphate for tobacco fertilizers is to be met promptly. Muriate is not acceptable for this one crop, because the chloride in the soil causes difficulty with the tobacco leaf. All other crops are less fussy about their potash food, agronomists report.

The only discordant note in this symphony of compliment is a press release from the Department of Agriculture announcing the taking of bids during October for six parcels of land still held by the Government around Searles Lake, California. By implication this government document undertakes to discredit the progress of the American industry and charge depletion of the reserves on the Government's part of the property without adequate payment. The industry does not appear to object to Mr. Ickes' effort to lease this land; but it is not pleased to be called names just when working so strenuously to care for the entire national need of this very vital raw material whether for fertilizer manufacture or for production of chemicals.

News "Fines"

Matches Flare Up—Some of the match makers caused Washington a number of uncomfortable minutes during September. The small firms in this industry were terrified at the thought that they might soon have to shut down because they had no chlorate of potash. Various official conferences were held. It soon developed that the domestic supply could, and shortly would, be made adequate and no one need resort to the colonial technic of lighting his cigaret with a glowing coal from the fireplace. It really surprises Washington how few such serious chemical shortages have been reported.

Paper Wages—The Secretary of Labor announces that those who want to sell paper to the Government after October 15 must meet the minimum wage scale fixed by order of September 26. Under the Walsh-Healey law, the minimum wages for workers of such firms will be 35 cents, 39 cents, or 50 cents per hour as a minimum according to the state in which they work. The Southern states are honored by the lowest minimum. The Pacific Coast had the highest.

Cellulose Sheet Troubles — Federal Trade Commission thinks that the members of National Converters Institute are guilty of conspiracy in fixing prices for transparent cellulose sheeting products. The Institute and its members are going

to be privileged to tell why they should not be cited with a cease and desist order for these alleged illegal practices.

Back Files of Magazines—Bibliofilm Service which works in the library of the United States Department of Agriculture is announcing that it will sell photographic reproduction of numerous rare and wanted back volumes of magazines. Those firms or individuals who are having trouble in getting this material are invited to subscribe for sets reproduced at a very low cost. Research directors have already indicated a cordial welcome for this new service.

New Metal Survey—The Bureau of Mines has been given special assistance by industry to inaugurate a monthly canvass of production, consumption, and stocks of strategic mineral commodities. This will permit much more prompt review of the rapidly changing situation. It is hoped that any acute shortages that might otherwise go undetected will be caught in time to prevent serious industrial difficulty.

Mineral Barter—Some officials have been worried about possible exhaustion of commodity reserves in the United States by export of semi-manufactured or finished products made from them. This, they fear, might leave the United States badly prepared for any later emergency if it should be dragged into hostilities. To prevent such complication, it is being proposed that foreign governments or industry wanting to buy such finished products should pay for them in part by arranging to supply needful raw material to replenish reserves. Whether this achieves official status or not, it is expected that some important units of industry will practice this policy. The idea is applicable to such things as rubber in tires, tin for containers, alloy in motor trucks, and like commodities which have nothing to do with actual munitions. Business men are expressing the hope that the trade restriction idea will not go too far lest California be prevented from exporting canned peaches because of the tin in the cans. Some workable program will have to be developed to mechanize the idea before it is officially adopted.

T.V.A. Phosphate—T.V.A. will spend $467,000 for washed phosphate rock under three contracts announced late in September. These will provide the necessary raw material for its experimental phosphoric acid furnace work.

Fire Brick Tests—New information regarding changes in dimensions during firing of raw clays will, Bureau of Standards specialists hope, assist in better planning for use of domestic clays in refractory brick making. Measurements are being reported on flint clays, kaolin, bauxite clay, and other varieties of refractory raw materials which have been tested in both granular and pulverized condition up to 1000° C.

Foreign Trade of Far East Affected By War

Special Correspondence

The suspension of German trade and shipping in the Far East is bound to divert Japanese, Chinese and Manchukuoan patronage to new sources of supply, among which the United States is likely to assume a preponderant place, so far as chemicals are concerned.

In spite of severe curtailments, Japanese imports of drugs, chemicals, medicines and explosives for the first six months of this year amounted to ¥88.1 million, with almost one-half provided by Germany. Japan's normal annual requirements in this merchandise group are in the region of ¥300 million.

In addition, Japan annually spends something like ¥30 million on imports of dyes, pigments etc. Actual imports for the first six months were returned at ¥5.1 million, with almost two-thirds supplied by Germany.

Japanese industrial leaders predict that Japan will inevitably make another giant stride towards world chemical power as the war drags on, just as she did during the Great War of 1914–18. During that war she laid the foundations of what has since developed into the world's fourth largest chemical industry.

Japan is now completely self-sufficient in, or has an exportable surplus of, most industrial chemicals. Significant exceptions are ammonium sulphate, potassium sulphate and chloride of potash. Deficiency of domestic production is most pronounced in coal-tar distillates and their derivatives, including intermediates, dyestuffs and pharmaceuticals. Another import item of some consequence is tanning extracts and tanning materials. An official plan has already been mapped out under which synthetic tanning materials are to be developed on a sufficient scale to meet domestic requirements. There is no doubt that the Department of Commerce and Industry in Tokyo will sooner or later come out with a similar plan to boost the production of coal-tar derivatives, the more so because an abundant domestic supply is essential to the functioning of the explosives industry.

The Chosen Electro-Metallurgical Co., a subsidiary of the Oriental Development Co. (which operates largely with American capital) will shortly start construction of a plant at Funei, Korea to produce acetylene from nitrogen of lime and carbide. Power for the project will be supplied by the Funei Hydro-Electric Co., another Oriental Development subsidiary. In addition to acetylene, it is planned to produce ferro-manganese and ferro-silicon at the projected plant.

The Manchuria Industrial Development Corp., which controls subsidiaries in all fields of industry in Manchukuo, is planning to establish a company for the production of industrial explosives. Demand for dynamite and other industrial explosives has greatly expanded in recent years and is expected to mount in the future as the expansion of mines and the completion of civil-engineering projects gathers momentum.

Production of industrial salt at the Changlu salt field, which Japan's chemical industry considers one of the most valuable assets of the Japanese-occupied territory in North China, has made an unexpectedly good showing owing to favorable weather conditions during the producing season (April to June). Production during the first six months of this year is estimated at 700,000 metric tons, exceeding the projected production for the whole of 1939 by 100,000 metric tons. Actual output for 1939 is expected to reach 800,000 metric tons, more than four times the volume produced in 1938. An amount of ¥4,000,000 has been earmarked for further development of the Changlu fields.

In cooperation with the Japan Oil Co., the Japan Mining Co., the Chosen (Korean) Nitrogen Co. and other domestic makers, the Department of Commerce and Industry in Tokyo has drafted a plan by which it is hoped to attain complete self-sufficiency for Japan in carbon black with home production able to fill all demands by February.

Major production increase schemes now under way include an attempt by the Chosen Nitrogen Co. to increase production of carbon black from carbide to 3 tons a day from the present daily output of 1 metric tons; by the Japan Oil Co. to advance the daily output at the Kinsui oil field (Formosa) from 6 metric tons to 8 metric tons; and a carbon black scheme by the Formosan Government-General's chemical laboratory.

Monthly demand for carbon black in Japan is in the neighborhood of from 250 to 300 tons. Domestic production early this year was rated at 100 metric tons.

Rankine Memorial Sponsored By Engineering Colleges

Under the leadership of Tau Beta Pi Chapter at Virginia Polytechnic Institute and endorsed by many leading engineering societies, engineers, and presidents of engineering colleges, a movement has been inaugurated to erect a memorial to the late Prof. William John MacQuorn Rankine at the University of Glasgow, Scotland. Professor Rankine occupied the chair of engineering at the University of Glasgow from 1855 until his death in 1872. The memorial is proposed as a recognition of his services as one of the chief founders of modern scientific engineering. It is to be a students' memorial and the plan calls for raising $15,000 by contributions from the 75,000 to 80,000 engineering students in American colleges and universities.

PERSONALITIES

✦ Louis Ware has been elected president of the International Agricultural Corp. He comes to his new position from the United Electric Coal Co. of which he was head.

✦ Kenneth H. Rockey has become chairman of the board of the Chilean Nitrate Sales Corp. in place of Gustavo Ross, who had resigned. J. Albert Woods has been made president of the corporation.

✦ D. T. McIver has been appointed assistant to the president of the Freeport Sulphur Co. Mr. McIver, a native of Texas, has been assistant general manager, with executive duties since 1933, being stationed in New Orleans. He will continue to act in that capacity also.

✦ A. S. Kloss, formerly manager of Georgia Naval Stores Operations of the Hercules Powder Co., with headquarters at Brunswick, Ga., has joined the Operating Department of the Naval Stores Department in Wilmington, Del.

✦ Reginald Rockwell, formerly superintendent of the naval stores plant of Hercules Powder Co. at Brunswick, Ga., has been appointed manager of Georgia Naval Stores Operations.

✦ George E. Bosserdet, formerly a supervisor of the naval stores plant of Hercules at Hattiesburg, Miss., will succeed Mr. Rockwell as superintendent of the plant at Brunswick, Ga.

✦ Howard Ten Broeck, a chemical engineer with the Brooklyn, N. Y., refinery of Socony-Vacuum has been elected secretary of the Junior Chemical Engineers of New York. He replaces Philip Otten of the Lummus Co. who has been stricken with appendicitis.

✦ Robert E. Wilson, president of Pan American Petroleum & Transport Co., will receive the Chemical Industry Medal of the Society of Chemical Industry on November 10. The medal is awarded annually for valuable application of chemical research to industry and will be given this year to Dr. Wilson in recognition of his research studies on a variety of subjects.

✦ Howard D. Lightbody has been appointed principal biochemist in the Western Research Laboratory of the U. S. Department of Agriculture. He will be located at Albany, Calif.

✦ Robert D. Coghill, formerly assistant professor of chemistry at Yale University, has been appointed chief of the fermentation division, Northern Regional Research Laboratory of the Department of Agriculture, at Peoria, Ill.

✦ P. Burke Jacobs has been appointed senior chemical engineer in the agricultural motor fuels division of the Northern Regional Research Laboratory.

✦ Lee T. Smith has been named to head the carbohydrate and derived products division of the Eastern Regional Research Laboratory.

✦ R. B. Moir, who resigned recently as chief engineer of W. A. Jones Foundry and Machine Co. has become associated with Foote Bros. Gear and Machine Corp. as director of sales, research and engineering development.

✦ Julian F. Smith becomes associate director of the Friends of the Hooker Scientific Library, Fayette, Missouri. He left the duPont company to accept this position. Dr. Neil E. Gordon is director of the Association and head of the Department of Chemistry at Central College, owner of the Library.

✦ Glenn O. Ebrey has been appointed to the staff of the Mellon Institute. He will study design, construction and operation of oil filters. For the past seven years he has been chief chemist of the Pennzoil Co., Oil City, Pa.

✦ H. R. Vollrath is now with the E. G. Budd Manufacturing Co., Philadelphia, Pa.

✦ J. L. Lonergan has been made vice-president and general manager of the Morris Machine Works of Baldwinsville, N. Y. His advancement follows more than 37 years of company service, the last 25 of which have been in executive positions.

✦ Donald W. Scott, research engineer, has been added to the technical staff of Battelle Memorial Institute, Columbus, Ohio.

✦ Andrew A. Holmes died September 22 in Roosevelt Hospital, New York, N. Y. He had been in poor health for some time and had submitted to an operation a week prior to his death.

✦ Thomas H. Chilton, director, technical division, engineering department, E. I. duPont de Nemours & Co., Inc., has been awarded the Charles Frederick Chandler Medal. The medal will be presented on November 16 when he will give the annual Chandler lecture at Columbia University during the celebration of the School of Engineering's seventy-fifth anniversary.

✦ E. J. Lowry has returned from Russia, where he was retained as chief metallurgist of Heavy Industries. He is now associated with the Woonsocket Color & Chemical Co. of Woonsocket, R. I.

✦ Albert I. Kegan, formerly with the U. S. Food and Drug Administration and the Chemistry faculty of Armour Institute of Technology, has opened consulting offices in Chicago.

✦ Robert S. Tipson, and Warner Carlson have been appointed to the staff of the Mellon Institute. Both chemists will be in the institution's department of research in pure chemistry.

✦ William K. Viertel has joined the faculty of the Virginia Polytechnic Institute. He goes to the new position after 12 years experience in industrial plants, most of which was with the Atmospheric Nitrogen Corp. and its successor the Nitrogen Division of the Solvay Process Co. at Syracuse and Hopewell.

✦ H. W. Graham, for many years general metallurgist of the Jones and Laughlin Steel Corp., has been changed to director of metallurgy and research.

✦ R. Carson Dalzell has been appointed technical advisor to the Baltimore Division of Revere Copper and Brass, Inc.

✦ J. B. Johnson has been appointed director of purchases for the Hercules Powder Co., Wilmington, Del. He succeeds H. F. Kolb, who has been transferred to the Casein Department of the Paper Makers Chemical Division of the company.

✦ Henry L. Ward has been appointed in charge of the design and construction of Western Electric Co's. factories here and abroad. He is a chemical engineering graduate of the University of Michigan. In 1911, he entered Western Electric at its Hawthorne Works.

✦ Edward Ryland was elected vice-president in charge of production at a recent meeting of the board of directors of the Virginia-Carolina Chemical Corp.

✦ George O. O'Hara has been appointed sales manager of the Electrode Division,

Dr. Francis C. Frary, director of research for the Aluminum Co. of America, awarded the Acheson Medal by the Electrochemical Society. Dr. Colin G. Fink, Dr. Frank J. Tone and Dr. Frederick M. Becket are former recipients of the honor.

Great Lakes Carbon Corp., Niagara Falls, N. Y.

✦ Leslie R. Bacon has accepted a position in the research organization of the J. B. Ford Co.

✦ James W. Hensley and Anton Vittone, Jr., recent graduates of the Universities of Colorado and Washington, respectively, have joined the staff of the J. B. Ford Co.

✦ Paul W. Soderberg, lately in charge of chemical activities of the J. B. Ford Co. has been advanced to the position of manager of technical sales service.

✦ M. M. Beckwith, formerly chief chemist for the Guide Lamp Division of General Motors, is now a technical representative of the J. B. Motor Sales Co.

✦ D. C. Jackson, Jr., has been selected as dean of the College of engineering at the University of Notre Dame.

✦ Ilona Tanssky, formerly of Vienna and London, has come to New York for the purpose of establishing advisory and consulting service in the oil and fat industries.

✦ V. C. Williams has been appointed assistant professor of chemical engineering at the University of Virginia. He has been a chemical engineer for Linde Air Products Co. and has been actively engaged in design and process development work.

✦ Francis C. Frary, director of research for the Aluminum Company of America, received the Acheson Medal and $1,000 prize on the occasion of the recent meeting of the Electrochemical Society in New York, N. Y. Dr. Frary was awarded the Medal for his work in developing important aluminum alloys.

✦ W. Ernest Henry, superintendent at Hercules Powder Co.'s chemical cotton plant, Hopewell, Va., has assumed the duties formerly carried out by Luke H. Sperry, manager, who has been appointed chief engineer with headquarters at Wilmington, Del.

✦ Fred G. Gronemeyer has been made plant manager of the Springfield plant of the Plastics Division of Monsanto Chemical Co. He had been resident engineer for the plant since April of this year.

✦ F. W. Mohlman and Rolf Eliassen have been appointed to the teaching staff of Armour Institute of Technology. Dr. Mohlman is adjunct professor in sanitary chemistry. Dr. Eliassen is assistant professor in sanitary engineering. The former was director of laboratories of the Chicago Sanitary District and the latter was a sanitary engineer with the Dorr Co.

✦ Elbert C. Lathrop is to head the work on the industrial utilization of agricultural wastes at the Northern Regional Research Laboratory of the Bureau of Agricultural Chemistry and Engineering. Dr. Lathrop has recently been vice-president in charge of technical activities of the Celotex Corp.

✦ Carl Lager, president of Morris Machine Works, Baldswinsville, N. Y., and a designer of pumping machinery, died recently at his home in the Adirondacks.

✦ L. G. E. Bignell was found dead in his home in Tulsa, Okla. He was well known in petroleum circles, having been secretary of the Petroleum Engineers club of Tulsa and the petroleum division of the A.I.M.E. Until June he was petroleum engineer editor of Oil & Gas Journal.

CALENDAR

NOV. 13-17, American Petroleum Institute, annual meeting, Stevens Hotel, Chicago.

NOV. 15-17, American Institute of Chemical Engineers, annual meeting, Providence-Biltmore Hotel, Providence, R. I.

DEC. 4-9, Chemical Exposition, Grand Central Palace, New York City.

FEB. 19-22, 1940, Technical Association of the Pulp & Paper Industry, annual meeting, Hotel Roosevelt, New York, N. Y.

APRIL 8-12, 1940, American Chemical Society, annual meeting, Cincinnati, Ohio.

APRIL 24-27, 1940, Electrochemical Society, annual meeting, Galen Hall, Wernersville, Pa.

Chemical ECONOMICS and MARKETS

CONSUMPTION OF CHEMICALS CONTINUES ON RAPIDLY RISING SCALE

UNDER the impetus of greatly enlarged operations at manufacturing plants, the movement of chemicals last month ran far ahead of that for any preceding month of the year. Business in general moved up in August and seasonal influences aided by the flood of buying orders which resulted from the outbreak of the war in Europe, carried the chemical industry to a point of activity not reached since 1937. Increased call for chemicals came from every consuming industry. While heavy buying on the part of manufacturers may have been partly due to a desire

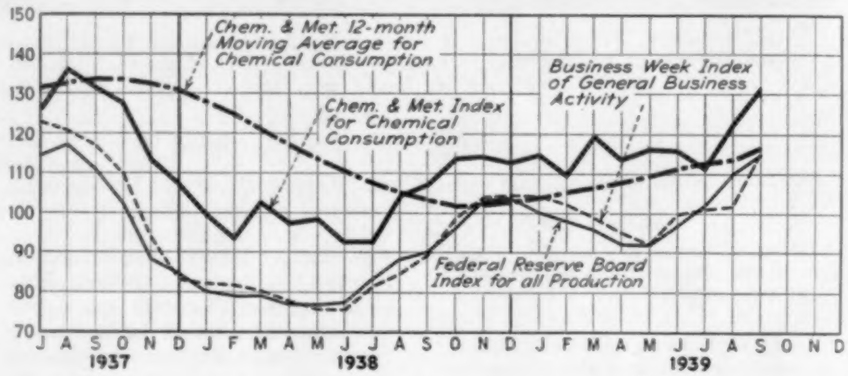
***Chem. & Met.* Index for Consumption of Chemicals**

	July Revised	August
Fertilizer	19.06	21.79
Pulp and paper	14.35	15.80
Glass	12.49	13.60
Petroleum refining	13.86	14.05
Paint and varnish	9.99	11.18
Iron and steel	6.76	7.56
Rayon	8.44	8.50
Textiles	7.10	8.01
Coal products	6.93	7.54
Leather, glue and gelatine	4.12	4.56
Explosives	4.04	4.77
Rubber	2.41	2.89
Plastics	1.86	1.96
	111.41	122.21

to accumulate stocks in anticipation of later price advances, it is certain that, in most cases, plant operations were forced to higher levels in order to meet the increase in demand for finished products.

From preliminary data, Chem. & Met's index for consumption of chemicals in September was substantially over 130 which compares with 107.12 for September last year. The revised index for August reveals that activities in the latter part of that month had risen sharply and the index rose to 122.21 as against 104.66 for August 1938. For the first three-quarters of this year the index records a gain of approximately 19 per cent over that for the like period of 1938. If the twelve-month moving average is projected along the line of its present movement, the December number—the average for the year—would rest around 125 to attain which would require an average of 148 for the consumption index over the final quarter.

For the current month, reports indicate that the rate of chemical consumption has been further increased. Some branches of the paper industry, notably



paperboard production, may create an all-time record. Production of plate and window glass is now expanding; steel and metallurgical plants are working at the highest rates of the year, in fact, this statement may be made for leather, paint and varnish, rayon, textiles, and plastics.

Regarding the outlook for the remainder of the year, economists in touch with conditions in each of the reserve districts, expect the Federal Reserve Board production index to reach 125 by the end of the year. Incidentally it is estimated that the index must reach 145 before full employment is provided. The Shippers Advisory Boards estimate freight car loadings for the final quarter at 13.8 per cent above those for the last quarter of 1938. Percentage changes forecast include: petroleum and products, 3.8; lime and plaster, 7.1; fertilizer, 12.7; paper and paperboard, 11.2; chemicals and explosives, 4.5. The estimate of gain for the movement of chemicals either did not take into consideration the rising demand for chemicals or it must indicate that a very large part of chemicals will be moved in trucks or some way other than in freight cars.

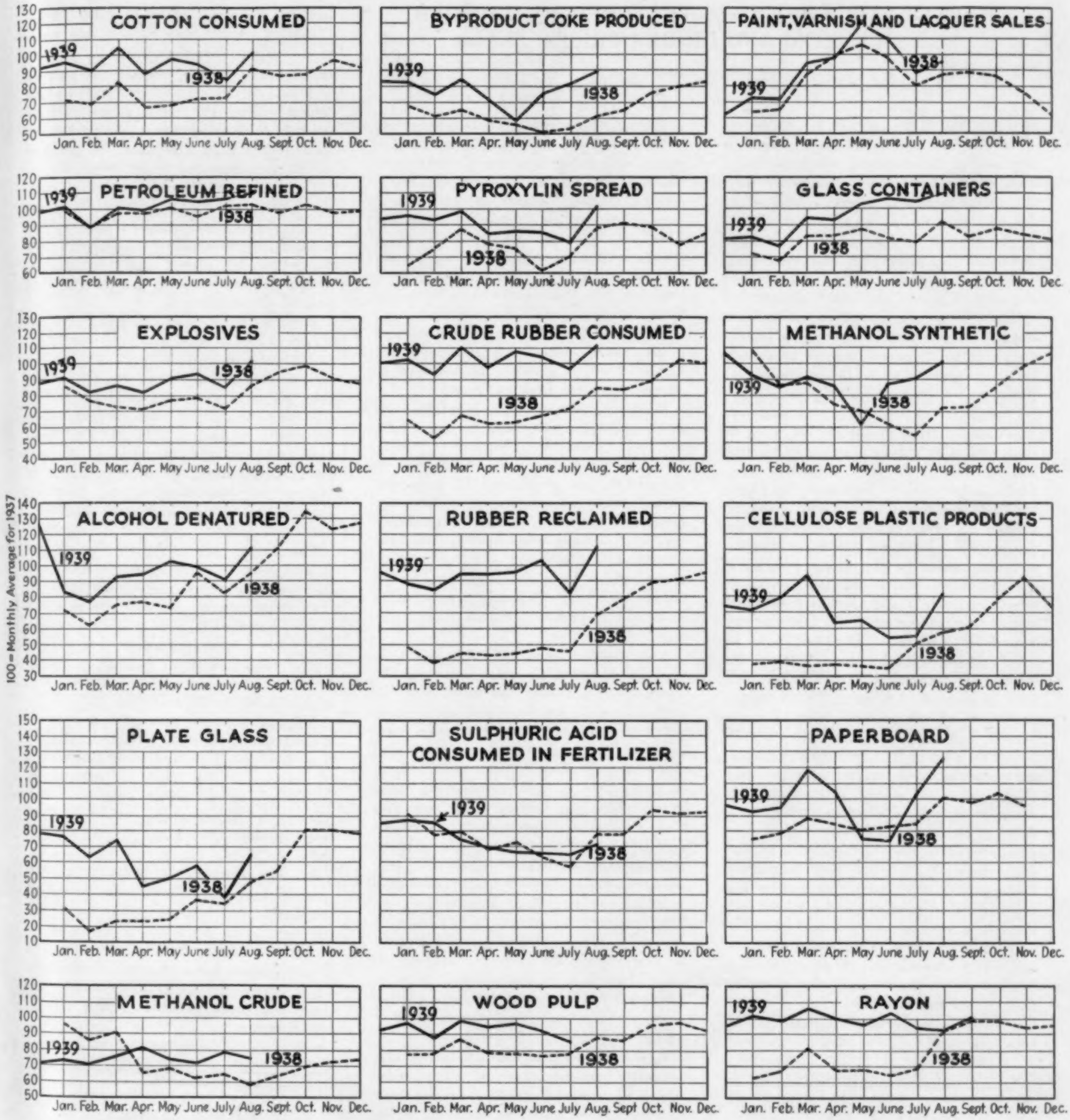
The Bureau of the Census reports sales of manufacturers in August at 13.6 per cent over those for August 1938. For individual groups the percentage gains include: textiles, 11.1; paper, 14.3; chemicals and allied products, 13.4; paint and varnish, 15.6; rubber products, 7.2; leather and products, 3.8; stone, clay, and glass 17.

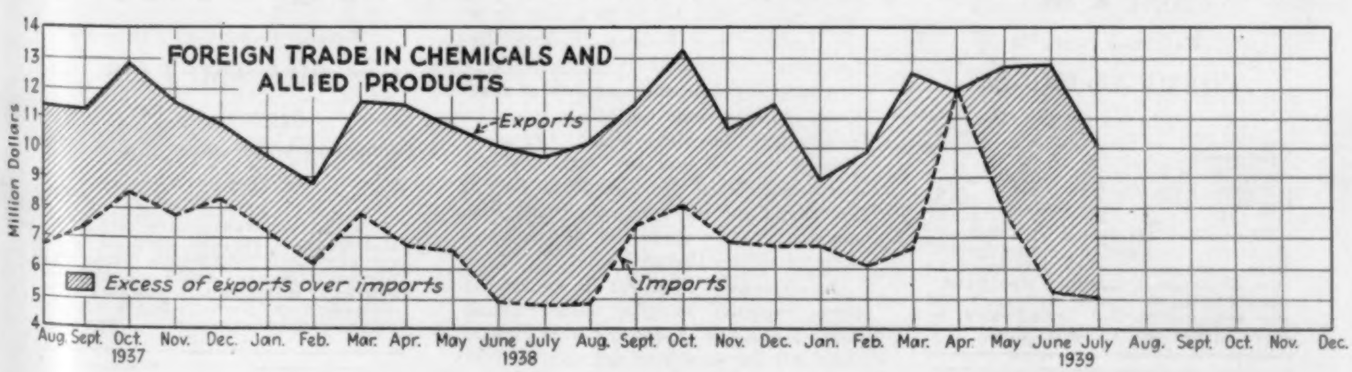
Production and Consumption Data for Chemical-Consuming Industries

Production	August 1939	August 1938	January-August 1939	January-August 1938	Per cent of gain for 1939
Alcohol, ethyl, 1,000 pr. gal	18,539	17,421	138,684	127,957	8.4
Alcohol denatured, 1,000 wi. gal	9,190	7,846	61,400	51,997	18.1
Ammonia, liquor, 1,000 lb	3,801	3,389	29,725	25,310	17.4
Ammonium sulphate, tons	50,565	34,841	346,249	267,434	29.5
Benzol, 1,000 gal	8,797	5,585	59,378	42,785	38.8
By-product coke, 1,000 tons	3,666	2,494	25,315	19,388	30.5
Glass containers, 1,000 gr	4,802	4,031	33,739	28,361	19.0
Plate glass, 1,000 sq.ft.	10,450	7,676	75,496	38,409	96.5
Methanol, synthetic, 1,000 gal	2,679	1,898	18,661	16,345	14.2
Methanol, crude, 1,000 gal	360	282	2,878	2,830	1.7
Nitrocellulose plastics, 1,000 lb	1,069	977	8,444	5,656	49.3
Cellulose acetate plastics, 1,000 lb.					
Sheets, rods, and tubes	1,041	546	6,010	2,851	110.8
Molding material	1,034	548	6,511	3,702	75.9
Rubber reclaimed, tons	17,214	11,317	116,353	61,566	89.0
Consumption					
Cotton, bales	628,448	559,409	4,683,877	3,664,962	27.8
Silk, bales	33,095	38,504	251,343	260,516	3.5*
Wool, 1,000 lb	34,311	29,161	251,585	154,818	62.5
Explosives, 1,000 lb	32,700	27,663	229,868	200,075	14.8
Rubber, crude, tons	50,481	40,552	368,927	249,832	48.1

* Per cent of decline.

Production and Consumption Trends





MARKET FOR CHEMICALS FEATURED BY HEAVIER BUYING AND HIGHER PRICES

TRADING in the market for chemicals in the last month has been somewhat reminiscent of conditions which prevailed during periods of the World War. Buying orders increased materially with many buyers apparently afraid that prices might get out of hand. Producers have done much to allay such fears and a review of the more important chemicals shows that prices have been remarkably stable. Where advances in price have been made, such action has been largely restricted to chemicals subject to outside influences and to those for which higher production costs were quickly established. In the latter group, the metal salts are prominent. Higher prices for copper, lead, and other metals necessarily affected the position of the salts and sales schedules were revised upwards for such products as white lead, red lead, litharge, orange mineral, copper carbonate, copper sulphate, antimony oxide, tin crystals, and tin oxide. In the group subject to outside influences would fall chemicals of foreign origin and domestic products which are produced from foreign raw materials. Chlorate of potash may be cited as an example of a chemical for which we are indebted to foreign markets as sources of supply. Following the cessation of shipments from Europe, match manufacturers in this country found themselves in a quandary regarding both prompt and future supplies. The relatively small stocks held here were eagerly sought and spot trading was done at prices considerably higher than had been in effect. The situation regarding future supplies has been brightened by reports that domestic production will be established at Oswego, N. Y. In fact, there are reports that different chemical manufacturers have been considering taking up production of chlorate. In connection with chlorate it is also pertinent to add that supplies of muriate of potash for chemical manufacture are not plentiful. Consumers who hold contracts with domestic producers are assured of deliveries but those who were covered ahead with shippers of the German product are not getting delivery and refineries at domestic plants are not able to step up production to meet this demand. There is no shortage of lower grade potash salts. Quicksilver was one of the first materials to exhibit a sky-rocketing tendency but there have been recessions from the peak levels reached and many hold the opinion that even the current prices are not warranted in view of the fact that ample stocks probably will be offered for some time to come.

Market quotations for vegetable oils and animal fats have been far more volatile than those for chemical products. The heavy buying in the oil market in September has given way to a quieter period with consumers apparently covered for the time being. Speculative trading has been prominent in the case of some of the oils and while prices have moved down from the high levels of a month ago, there is strong sentiment in favor of still higher prices later on in the year.

Considerable comment was heard in the market about an order issued by the Treasury Department, effective Sept. 30 and forbidding the disclosure of information on import and export data, this order to continue as long as a state of war existed abroad. In the Federal *Register* of Oct. 3, the following paragraph regarding foreign trade statistics was published: *Statistics furnished by collectors of customs.* Trade papers, trade organizations, and commercial concerns may be furnished with statistical information regarding imports by customs districts as shown in the monthly statistical reports supplied to collectors by the Section of Customs Statistics at New York. In no case shall any information be furnished in such manner as to disclose individual transactions or names of importers or exporters.

It is possible that war conditions may stimulate consumption in the United States of mangrove tanning extract from sources nearer home, as occurred in the war period 1914 to 1918, according to the Leather and Rubber Division, Department of Commerce.

Almost inexhaustible supplies of mangrove exist in some Caribbean countries particularly in Mexico and Colombia. During the last war two extract plants were estabilshed in Colombia, one at Cartagena and the other at Cispata Bay, almost the entire production of which was shipped to the United States.

In 1915 over 1,800,000 lb. of extract were exported to this country from Colombia. The following year nearly 2,800,000 lb. were received and in 1917 imports were just short of 2,000,000 lb. Cessation of the war caused this trade to dwindle to less than 4,000 lb. in 1919 and ceased entirely shortly thereafter.

According to information recently obtained, there has been some activity toward re-establishing a mangrove extract industry in Colombia. A national company is reported to be in process of organization for the exploitation of mangrove resources along the Sinu River for which the Colombian Government has granted the necessary concessions. The plant is to be located at Turbo, a town on the Atlantic coast in the northwestern part of the country.

Exports from the United States of chemical and related products continued to advance in August with all leading classes except fertilizers sharing in the gain. Shipments of such products to foreign countries exceeded $15,000,000 during the month, compared with $13,459,000 in July, and $12,000,000 during August, 1938. Outstanding gains were noted in exports of coal-tar products, sulphur, chemical specialties, industrial chemicals, and medicinals.

Comparing exports during the current August with the corresponding month of last year, the Chemical Division reported that shipments of coal-tar products advanced in value from $526,000 to $1,105,000. In this classification exports of benzol increased from 347,000 to 2,238,500 gal. and colors, dyes, stains, etc., from 474,000 to 872,000 lb.

Sulphur exports advanced sharply to a total valuation of $1,450,000 in August from $457,000 in the corresponding month of last year. By quantity, exports of crude sulphur increased from 23,600 to 82,831 tons during these periods and refined sulphur from 1,767,200 to 2,660,600 lb.

In the meantime it looks as though luxuries and non-essentials are wiped off the Latin American shopping list. Even the volume of essentials is likely to be curtailed unless more money for the Export-Import bank or other credits can be secured—and Latin America has not done everything possible to keep a high credit rating.

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base=100 for 1937

This month	**97.56**
Last month	97.12
October, 1938	98.74
October, 1937	100.38

The market has firmed with different chemicals commanding higher prices. Metal salts again were prominent in the advances. Quotations are practically limited to nearby deliveries and the new contracting period may be deferred beyond the usual time.

CHEM. & MET.

Weighted Index of Prices for

OILS AND FATS

Base=100 for 1937

This month	**84.27**
Last month	84.27
October, 1938	73.50
October, 1937	89.83

The market was quieter last month and many of the oils dropped below the price levels reached a month ago. Animal fats also eased off and the course of values is now marking time, dependent on fluctuations in trading volume.

Current PRICES

INDUSTRIAL CHEMICALS

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.06 -$0.06½	$0.05½-$0.06½	$0.05½-$0.06½
Acid, acetic, 28%, bbl., cwt.	2.23 - 2.48	2.23 - 2.48	2.23 - 2.48
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.25 -10.50	10.25 -10.50	10.25 -10.50
Boric, bbl., ton	106.00-111.00	106.00-111.00	106.00-111.00
Citric, kegs, lb	.20 - .23	.20 - .23	.23½- .26
Formic, bbl., ton	.10½- .11	.10½- .11	.10½- .11
Gallic, tech., bbl., lb	.70 - .75	.70 - .75	.70 - .75
Hydrofluoric 30% carb., lb	.07 - .07½	.07 - .07½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb	.06½- .06¾	.06½- .06¾	.06½- .06¾
Muriatic, 18°, tanks, cwt	1.05 -......	1.05 -......	1.05 -......
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -......	18.50 -20.00
Oxalic, crystals, bbl., lb	.10¾- .12	.10¾- .12	.10¾- .12
Phosphoric, tech., c'bys., lb	.07½- .08½	.07½- .08½	.09 - .10
Sulphuric, 60° tanks, ton	13.00 -......	13.00 -......	13.00 -......
Sulphuric, 66°, tanks, ton	16.50 -......	16.50 -......	16.50 -......
Tannic, tech., bbl., lb	.40 - .45	.40 - .45	.40 - .45
Tartaric, powd., bbl., lb	.31¼-......	.27½-......	.27½-......
Tungstic, bbl., lb	2.35 -......	2.35 -......	2.75 -......
Alcohol, Amyl	....-......	....-......	....-......
From Pentane, tanks, lb	.101-......	.101-......	.106-......
Alcohol, Butyl, tanks, lb	.08 -......	.07 -......	.08½-......
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.54 -......	4.54 -......	4.58½-......
Denatured, 190 proof			
No. 1 special, bbl., gal. wks.	.28½-......	.26½-......	.30 -......
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Potash, lump, bbl., lb	.03¾- .04	.03¾- .04	.03¾- .04
Aluminum sulphate, com. bags, cwt	1.15 - 1.40	1.15 - 1.40	1.15 - 1.40
Iron free, bg., cwt	1.30 - 1.55	1.30 - 1.55	1.30 - 1.55
Aqua ammonia, 26°, drums, lb	.02½- .03	.02 - .03	.02½- .03
tanks, lb	.02 - .02¾	.02 - .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb	.15½-......	.15½-......	.15½-.16
tanks, lb	.04½-......	.04½-......	.04½-.16
Ammonium carbonate, powd. tech., casks, lb	.09 - .12	.08 - .12	.08 - .12
Sulphate, wks, cwt	1.40 -......	1.40 -......	1.365-......
Amylacetate tech., tanks, lb	.10½-......	.09½-......	.11 -......
Antimony Oxide, bbl., lb	.17 - .18	.11 - .12	.11½- .12
Arsenic, white, powd., bbl., lb	.03 - .03½	.03 - .03½	.03 - .03½
Red, powd., kegs, lb	.15½- .16	.15½- .16	.15½- .16
Barium carbonate, bbl., ton	52.50 -57.50	52.50 -57.50	52.50 -57.50
Chloride, bbl., ton	79.00 -81.00	79.00 -81.00	79.00 -81.00
Nitrate, casks, lb	.07 - .08	.07 - .08	.07 - .08
Blanc fixe, dry, bbl., lb	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f. o. b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	48.00 -51.00	48.00 -51.00	48.00 -51.00
Bromine, cs., lb	.30 - .32	.30 - .32	.30 - .32
Calcium acetate, bags	1.75 -......	1.65 -......	1.65 -......
Arsenate, dr., lb	.06¾- .07	.06¾- .07	.06¾- .07
Carbide drums, lb	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., del., ton	21.50 -24.50	21.50 -24.50	21.50 -24.50
flake, dr., del., ton	23.00 -25.00	23.00 -25.00	23.00 -25.00
Phosphate, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb	.05 - .06	.05 - .06	.05 - .06
Tetrachloride drums, lb	.04¾- .05½	.04¾- .05½	.05½- .06
Chlorine, liquid, tanks, wks., lb	1.75 -......	1.75 -......	2.15 -......
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.67 - 1.70	1.67 - 1.70	1.67 - 1.70
Copperas, bgs., f. o. b., wks., ton	17.00 -18.00	15.00 -16.00	15.00 -16.00
Copper carbonate, bbl., lb	.10 - .16½	.10 - .16½	.09 - .16
Sulphate, bbl., cwt	4.75 - 5.00	4.60 - 4.85	4.40 - 4.65
Cream of tartar, bbl., lb	.25¼-......	.24½-......	.22¾-......
Diethylene glycol, dr., lb	.22 - .23	.22 - .23	.22 - .23
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80 - 2.00
Ethyl acetate, drums, lb	.061-......	.061-......	.06½-......
Formaldehyde, 40%, bbl., lb	.05¾- .06½	.05¾- .06½	.05¾- .6½
Furfural, tanks, lb	.09 -......	.09 -......	.09 -......
Fusel oil, ref. drums, lb	.16 - .17	.12½- .14	.12½- .14
Glaubers salt, bags, cwt	.95 - 1.00	.95 - 1.00	.95 - 1.00
Glycerine, c.p., drums, extra, lb.	.12½-......	.12½-......	.16¼-......
Lead:			
White, basic carbonate, dry casks, lb	.07 -......	.07 -......	.06¾-......
White, basic sulphate, sck., lb	.06½-......	.06½-......	.06¾-......
Red, dry, sck., lb	.08 -	.08 -	.08 -......
Lead acetate, white crys., bbl., lb.	.11 - .12	.10½- .11	.10 - .11
Lead arsenate, powd., bbl., lb	.10 - .10½	.10 - .10½	.11 - .11½
Lime, chem., bulk, ton	8.50 -......	8.50 -......	8.50 -......
Litharge, pwd., csk., lb	07 -......	.0685-......	.066-......
Lithophone, bags, lb	.04 - .04½	.04 - .04½	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½

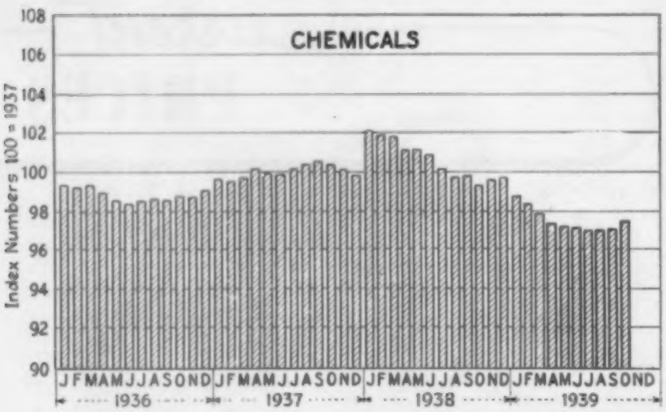
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Oct. 13

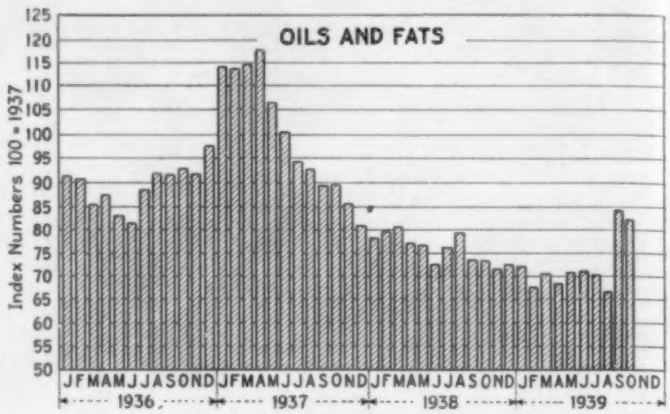
	Current Price	Last Month	Last Year
Methanol, 95%, tanks, gal	.31 -......	.31 -......	.31 -......
97%, tanks, gal	.32 -......	.32 -......	.32 -......
Synthetic, tanks, gal	.33 -......	.33 -......	.33 -......
Nickel salt, double, bbl., lb	.13 - .13½	.13 - .13½	.13 - .13½
Orange mineral, csk., lb	.10¾-......	.10½-......	.10½-......
Phosphorus, red, cases, lb	.40 - .42	.40 - .42	.40 - .42
Yellow, cases, lb	.18 - .25	.18 - .25	.24 - .30
Potassium bichromate, casks, lb.	.08½- .09	.08½- .09	.08½- .09
Carbonate, 80-85%, calc. csk., lb	.06½- .07	.06½- .07	.06½- .07
Chlorate, powd., lb	nom.	.09½-......	.09½-......
Hydroxide (c'stic potash) dr., lb	.07 - .07½	.07 - .07½	.07 - .07½
Muriate, 80% bgs., unit	.53½-......	.53½-......	.53½-......
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb	.18½- .19	.18½- .19	.18½- .19
Prussate, yellow, caks, lb	.15 - .16	.14 - .15	.15 - .16
Sal ammoniac, white, casks, lb	.05 - .05½	.05 - .05½	.05 - .05½
Salsoda, bbl., cwt	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt	1.05 -......	1.05 -......	1.05 -......
Dense, bags, cwt	1.10 -......	1.10 -......	1.10 -......
Soda, caustic, 76%, solid, drums, cwt	2.30 - 3.00	2.30 - 3.00	2.30 - 3.00
Acetate, works, bbl., lb	.04 - .05	.04 - .05	.04½- .05
Bicarbonate, bbl., cwt	1.70 - 2.00	1.70 - 2.00	1.75 - 2.00
Bichromate, casks, lb	.06½- .07	.06½- .07	.06½- .07
Bisulphate, bulk, ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Bisulphite, bbl., lb	.03¾- .04	.03¾- .04	.03¾- .04
Chlorate, kegs, lb	.06¾- .06½	.06¾- .06½	.06¾- .06½
Cyanide, cases, dom., lb	.14 - .15	.14 - .15	.14 - .15
Fluoride, bbl., lb	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., cwt	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt	2.20 - 3.20	2.20 - 3.20	2.20 - 3.20
Nitrate, bulk, cwt	1.35 -......	1.35 -......	1.45 -......
Nitrite, casks, lb	.06¾- .07	.06¾- .07	.07 - .08
Phospate, tribasic, bags, lb	2.00 -......	1.85 -......	1.85 -......
Prussiate, yel. drums, lb	.10½- .11	.09½- .10	.09½- .10
Silicate (40° dr.) wks., cwt	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused, 60-62%, dr., lb.	.02¾- .03½	.02¾- .03	.02¾- .03
Sulphite, crys., bbl., lb	.02¾- .02½	.02¾- .02½	.02¾- .02½
Sulphur, crude at mine, bulk, ton.	16.00 -......	16.00 -......	18.00 -......
Chloride, dr., lb	.03 - .04	.03 - .04	.03 - .04
Dioxide, cyl., lb	.07 - .08	.07 - .08	.07 - .07½
Flour, bag, cwt	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb	.54 -......	.54 -......	.48 -......
Crystals, bbl., lb	.50½-......	.50½-......	.35 -......
Zinc. chloride, gran., bbl., lb	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb	.14 - .15	.14 - .15	.14 - .15
Cyanide, dr., lb	.33 - .35	.33 - .35	.33 - .35
Dust, bbl., lb	.08½-......	.08 -......	.06¾-......
Zinc oxide, lead free, bag., lb	.06¾-......	.06½-......	.06¾-......
5% lead sulphate, bags, lb	.06½-......	.06½-......	.06¾-......
Sulphate, bbl., cwt	2.75 - 3.00	2.75 - 3.00	3.15 - 3.60

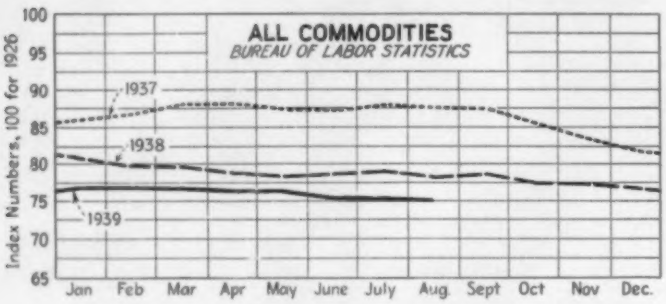
OILS AND FATS

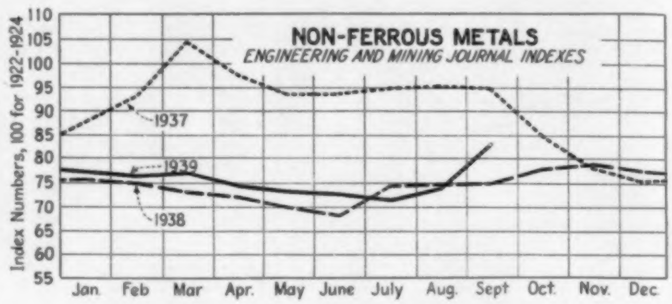
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.09½-$0.10	$0.08½-$0.10	$0.09½-$0.10
Chinawood oil, bbl., lb	.28 -......	.27 -......	.12½-......
Coconut oil, Ceylon, tank, N. Y., lb	.04 -......	.04½-......	.03¼-......
Corn oil crude, tanks (f. o. b. mill), lb	.06½-......	.07 -......	.07 -......
Cottonseed oil, crude (f. o. b. mill), tanks, lb	.05¾-......	.06¼-......	.06½-......
Linseed oil, raw car lots, bbl., lb	.105-......	.10 -......	.086-......
Palm, casks, lb	.04½-......	.04½-......	.03½-......
Peanut oil, crude, tanks (mill), lb.	.07 -......	.07 -......	.07 -......
Rapeseed oil, refined, bbl., gal	.95 -......	.90 -......	.75 -......
Soya bean, tank, lb	.05½-......	.06 -......	.05¾-......
Sulphur (olive foots), bbl., lb	.10 -......	.08 -......	.06½-......
Cod, Newfoundland, bbl., gal	nom.	.32 -......	.38 -......
Menhaden, light pressed, bbl., lb.	.076-......	.068-......	.061-......
Crude, tanks (f. o. b. factory), gal	.36 -......	.30 -......	.30 -......
Grease, yellow, loose, lb	.05¼-......	.05¾-......	.04¾-......
Oleo stearine, lb	.09 -......	.09 -......	.07 -......
Oleo oil, No. 1	.08½-......	.07½-......	.09½-......
Red oil, distilled, d.p. bbl., lb	.07¾-......	.07¾-......	.08¾-......
Tallow extra, loose, lb	.06 -......	.06 -......	.05½-......

Chem. & Met.'s Weighted Price Indexes









COAL-TAR PRODUCTS

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb	$0.52 -$0.55	$0.52 -$0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb	.22 - .24	.22 - .24	.22 - .24
Benzaldehyde, U.S.P., dr., lb	.85 - .95	.85 - .95	.85 - .95
Benzidine base, bbl., lb	.70 - .75	.70 - .75	.70 - .75
Benzoic acid, U.S.P., kgs., lb	.54 - .56	.54 - .56	.54 - .56
Benzyl chloride, tech., dr., lb	.23 - .25	.23 - .25	.25 - .27
Benzol, 90%, tanks, works, gal	.16 - .18	.16 - .18	.16 - .18
Beta-napthol, tech., drums, lb	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb	.09½- .10	.09½- .10	.10½- .11
Cresylic acid, dr., wks., gal	.58 - .60	.55 - .57	.78 - .80
Diethylaniline, dr., lb	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluen, bbl., lb	.15 - .16	.15 - .16	.15 - .16
Dip oil, 15%, dr., gal	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, bbl., lb	.32 - .36	.32 - .36	.32 - .36
H-acid, bbl., lb	.50 - .55	.50 - .55	.50 - .55
Naphthalene, flake, bbl., lb	.05½- .06	.05½- .06	.05¾- .06
Nitrobenzene, dr., lb	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb	.47 - .49	.47 - .49	.50 - .52
Phenol, U.S.P., drums, lb	.13 -......	.13 -......	.14½-......
Picric acid, bbl., lb	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal	1.55 - 1.60	1.55 - 1.60	1.55 - 1.60
Resorcinal, tech., kegs, lb	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb	.33 - .40	.33 - .40	.33 - .40
Solvent naptha, w.w., tanks, gal	.26 -......	.26 -......	.26 -......
Tolidine, bbl., lb	.86 - .88	.86 - .88	.88 - .90
Toluene, drums, works, gal	.27 -......	.27 -......	.27 -......
Xylene, com, tanks, gal	.26 -......	.26 -......	.26 -......

MISCELLANEOUS

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech., bbl., lb	.20 - .22	.14 - .15½	.08½- .11
China clay, dom., f.o.b. mine, ton	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb	.02½- .30	.02½- .30	.02½- .30
Prussian blue, bbl., lb	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb	.10 - .26	.10 - .26	.10 - .26
Chrome green, bbl., lb	.21 - .30	.21 - .30	.21 - .27
Carmine red, tins, lb	4.85 - 5.00	4.35 - 4.40	4.00 - 4.40
Para toner, lb	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb	2.40 - 2.50	2.40 - 2.50	1.50 - 1.55
Chrome yellow, C.P., bbl., lb	.14½- .15½	.14½- .15½	.14½- .15½
Feldspar, No. 1 (f.o.b. N.C.), ton	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb	.06 - .06½	.06 - .06½	.06 - .06½
Gum copal Congo, bags, lb	.07 - .30	.07 - .30	.06 - .30
Manila, bags, lb	.08 - .15	.08 - .14	.09 - .14
Damar, Batavia, cases, lb	.08 - .20	.08 - .20	.08 - .24
Kauri cases, lb	.18 - .60	.18 - .60	.18½- .60
Kieselguhr (f.o.b. N. Y.), ton	50.00 -55.00	50.00 -55.00	50.00 -55.00
Magnesite, calc, ton	50.00 -......	50.00 -......	50.00 -......
Pumice stone, lump, bbl., lb	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb	.03 - .04	.03 - .04	.03 - .04
Rosin, H., bbl	6.70 -......	6.95 -......	6.65 -......
Turpentine, gal	.33 -......	.31½-......	.27 -......
Shellac, orange, fine, bags, lb	.25 -......	.22 -......	.20 -......
Bleached, bonedry, bags, lb	.24 -......	.21 -......	.19 -......
T. N. Bags, lb	.16 -......	.14 -......	.11 -......
Soapstone (f.o.b. Vt.), bags, ton	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc, 200 mesh (f.o.b. Vt.), ton	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
300 mesh (f.o.b. Ga.), ton	7.50 -10.00	7.50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13.75 -......	13.75 -......	13.75 -......

INDUSTRIAL NOTES

Monsanto Chemical Co., St. Louis, has opened an office for its plastics division in the Union Guardian Bldg, Detroit. George C. Gress has been moved from Springfield, Mass., to take charge of the new office.

Food Machinery Corp., Los Angeles, has purchased the Kimball-Krogh Pump Co., a subsidiary of the Victor Equipment Co.

Reichold Chemicals, Inc., Detroit, has added Dr. C. Knauss to its staff in the New York office. Dr. Knauss will serve in a sales and servicing capacity.

Allis-Chalmers Mfg. Co., Milwaukee, has moved W. F. Daly from Chicago to district office manager at St. Louis. C. L. Orth who managed the St. Louis office for the last twenty-nine years will continue in a consulting and sales capacity.

Union Carbide and Carbon Corp., New York, has moved its general publicity office from 205 East 42d St. to 30 East 42d St.

Morris Machine Works, Baldwinsville, N. Y., has appointed Pierce J. McAuliffe as New York representative with offices at 254 West 31st St.

Link-Belt Co., Chicago, has selected Harry E. Kellogg as treasurer and F. V. MacArthur as secretary. This action resulted from the resignation of Richard W. Yerkes as secretary-treasurer after a half century's connection with the company.

The Porcelain Enamel & Mfg. Co., Baltimore, has advanced Walter B. Wessels from assistant treasurer to the position of secretary of the company.

Lebanon Steel Foundry, Lebanon, Pa., has added Edward H. Platz, Jr., to the staff of its alloy steel sales department.

Blaw-Knox Co., Pittsburgh, has selected Lawrence E. Joseph to its board of directors. Mr. Joseph was recently appointed executive head of the Blaw-Knox Division.

New CONSTRUCTION

	Current Projects		Cumulative 1939	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	....	$220,000	$1,335,000	$1,668,000
Middle Atlantic	....	710,000	6,330,000	14,907,000
South	$1,365,000	240,000	12,308,000	10,435,000
Middle West	3,575,000	1,020,000	15,665,000	15,635,000
West of Mississippi	40,000	2,660,000	7,935,000	12,356,000
Far West	1,625,000	40,000	2,270,000	3,232,000
Canada	....	40,000	8,960,000	5,095,000
Total	$6,605,000	$4,930,000	$54,803,000	$63,328,000

PROPOSED WORK

Battery Plant—General Dry Batteries, Inc., Lakewood, O., has purchased the former plant of the Carrollton China Co., Carrollton, O., and plans to improve and remodel same for the manufacture of dry cell batteries. $40,000.

Factory—Eastman Kodak Co., Kodak Park, Rochester, N. Y., plans to construct an addition to its factory. $250,000.

Crude Oil Refinery—United Refining Co. H. A. Logan, Treas. and Gen. Mgr., Box 780, Warren, Pa., plans to construct large addition to crude oil refinery also improvements and alterations to its plant. Cost will exceed $115,000.

Gasoline Refinery—Sinclair-Prairie Oil Co., Corpus Christi, Tex., plans to construct a gasoline refinery in East White Point Field, San Patrico Co., near St. Paul and Sinton, Tex., to be absorption type maximum processing capacity 5,000,000 cu. ft. gas daily and gasoline capacity 7,000 gal. daily. $175,000. Company will also install gathering pipe lines connecting from points in field to refinery to cost $70,000.

Gasoline Refinery—Texas Oil Products Co. Gladewater, Tex., plans improvements to its gasoline plants and oil refinery located near Gladewater. Cost will exceed $40,000.

Oil Refinery—Magnolia Petroleum Co., 1009 Fannin St., Houston, Tex., will soon receive bids for the construction of a 1-story Ethyl gasoline plant at Beaumont, Tex. $90,000.

Oil Refinery—Republic Oil Refining Co., Benedum Tress Bldg., Pittsburgh, Pa. plans to construct a new cracking plant at its refinery at Texas City, Tex., $1,000,000. A new electric power plant will also be built to cost $250,000.

Oil Refinery—Yazoo Refining Co., Inc., Yazoo City, Miss., plans to construct a refinery to have a capacity of 2000 bbl. per day. $75,000.

Pulp Mill—Florida Pulp & Paper Co., c/o John C. Pace, Pres., contemplates construction of mill at Pensacola, Fla. $3,000,000.

Paper Carton Factory—Rathbore, Hair & Ridgeway Co., 1440 West 21st Pl., Chicago, Ill., contemplates construction of factory near North Charleston, S. C. Estimated cost $500,000.

Pipe Line—Tidewater-Seaboard Oil Co., Cayuga and Palestine, Tex., plans to construct 4 in. c.i. welded joint distillate pipe line between recycling plants at Long Lake and Cayuga about 45 mi. J. B. Moore, Jr., c/o owners, Engr. $70,000.

Salt Brine Project—Owner c/o Ford, Bacon & Davis, Cons. Engrs., 39 Bway., New York, N. Y., plans to construct a salt brine project at Middlebury, N. Y. Project will include brine pumping station, pipe line from Dale (Wyoming Co.) to Niagara Falls, N. Y., to pump brine for use of chemical plants in that vicinity and dam. $1,000,000.

CONTRACTS AWARDED

Brick Plant—Modern Brick & Tile Corp., c/o F. N. Brooker, 711 Washington St., Dayton, O. will construct brick manufacturing plant at Englewood, O., using own forces. $50,000.

Chemical Plant—Dewey & Almy Chemical Co., 62 Whittemore Ave., Cambridge, Mass., have awarded contract for addition to building No. 7, to L. C. Blake, 50 Dyer Ave., Milton, Mass. $40,000.

Chemical Plant—Harshaw Chemical Co., 1945 East 97th St., Cleveland, O., has awarded contract for plant addition to E. C. F. Shafer Co., Caxton Bldg. Cleveland. $40,000.

Chemical Plant—Presidio Realty Holders, Inc., 23-28 50th Ave., Long Island City, N. Y., have awarded contract for plant at 5-23 23rd St., Long Island City, to Brown & Matthews, Inc., 122 East 42nd St., New York, N. Y. $45,000.

Cleaning Fluid Factory—Roman Cleanser Co., 2700 East McNichols Rd., Detroit, Mich., has awarded contract for factory addition to Barton Marlow Co., 1900 East Jefferson Ave., Detroit. $40,000.

Dilution Plant—Koppers Co., 1000 North Hamline Ave., St. Paul, Minn. will construct plant with own forces. $40,000.

Creosote Treating Plant—Wood Preserving Corporation of America, Koppers Bldg., Pittsburgh, Pa., is rebuilding plant on King St. Ext., Charleston, S. C., recently destroyed by explosion. Own forces. $200,000.

Factory—Eastman Kodak Co., Kodak Park, Rochester, N. Y., has awarded contract for improvements and addition to building No. 30 to Ridge Construction Co., Kodak Park. $40,000.

Glauber Salt Plant—Hartford Rayon Corp., Dividend St., Rocky Hill, Conn., has awarded contract for 3 story reclamation plant addition to produce Glauber salts to Denis O'Brien & Sons, Inc., 190 Trumbull St., Hartford. $60,000.

Graphite Bronze Factory — Cleveland Graphite Bronze Co., F. Saltzman, 880 East 72nd St., Cleveland, O., has awarded contract for addition to A. M. Higley Co., 2036 East 22nd St., Cleveland. $80,000.

Lead Factory—National Lead Co., 111 Bway., New York, N. Y., has awarded contract for altering 2 story factory at 161-69 Marshall St., Brooklyn, N. Y., to Wm. L. Crow Construction Co., 101 Park Ave., New York, N. Y. $50,000.

Crude Oil Development—Benedum-Trees Oil Co., Benedum Trees Bldg., Pittsburgh, Pa., has awarded separate contracts for drilling 4 or more 1,800 ft. wells for crude oil development near Bradford, Pa. Bids will soon be received for furnishing steel storage tankage, pipe for wells and connecting pipe lines. $35,000.

Gasoline Refinery—General American Gasoline Co., Gladewater, Tex., will construct a hydro-carbon extracting unit to present casinghead plant near Gladewater. Work will be done by owners. $80,000.

Cracking Plant—Kendall Refining Co., Kendall Ave. Bradford, Pa., has awarded contract for plant to M. W. Kellogg Co., 225 Bway., New York City. $250,000.

Oil Refinery—Shell Oil Co., Inc., 1221 Locust St., St. Louis, Mo., has awarded contract for addition to Deer Park oil refinery on LaPorte Rd., Houston, Tex., to C. F. Braun & Co., Esperson Bldg., Houston. $1,000,000.

Bulk Plant—Shell Union Oil Corp., 50 West 50th St., New York, N. Y., has awarded contract for addition to bulk plant at South Portland, Me., to John A. Simonds Co., 12 Monument Sq., Portland.

Recycling Plant—Tidewater Associated Oil Co., Cayuga, Tex., has awarded contract for recycling plant and refinery to Frick-Reid Co., 108 North Trenton St., Tulsa. $1,600,000.

Oxygen Plant—Independent Oxygen Co., c/o L. E. Sherman, Dallas Ave., North College Hill, Cincinnati, O., has awarded contract for 1 story, 40x100 ft. plant on Main St., near Amity Rd., Reading, O., to John Rolfe, 222 East 12th St., Cincinnati. $100,000.

Paper Mill—Atlanta Paper Co., 225 Moore St., S. E., Atlanta, Ga., has awarded contract for 1 story, 100x175 ft. addition to mill to Capitol Construction Co., 62 Bartow St., N. W., Atlanta, Ga.

Paper Mill—Louis Dejounge Co., Oak Hill Ave., Fitchburg, Mass., has awarded contract for mill addition to B. A. Wade Co., 336 Main St., Fitchburg; steel to Eastern Bridge & Structure Co., 88 Crescent St., Worcester. $40,000.

Paper Mill—Marathon Paper Mills Co., Marathon, Wis., has awarded contract for 1 story, 80x100 ft. addition to its factory at Ashland, Wis., to R. J. Murphy Co., Ashland.

Paper Mill—Rising Paper Co., Housatonic, Mass., has awarded contract for 2 story, 40x80 ft. addition to mill to Ernest F. Carlson, Inc., 1694 Main St., Springfield. $40,000.

Pulp Mill—Soundview Pulp Co., Everett, Wash., has awarded contract for mill addition, with six concrete bleach tanks, to Austin Co., 16112 Euclid Ave., Cleveland. $40,000.

Porcelain Factory—Wisconsin Porcelain Co., Sun Prairie, Wis., has awarded lumber contract for 1 story, 80x214 ft. factory to Stegerwald Lumber Co., Sun Prairie; steel to Theo. Kupfer Foundry & Iron Works, Madison; reinforcing steel to Bethlehem Steel Co., 735 North Water St., Milwaukee.

Rubber Factory—Bolta Rubber Co., Inc., 151 Canal St., Lawrence, Mass., has awarded contract for 1 story, 70x240 ft. factory at Granby, Que., to Leo Gendreau, Ltd., 366 Main St., Granby. $40,000.

Rubber Factory—Gillette Rubber Co., 799 Wisconsin St., Eau Claire, Wis., has awarded contract for alterations and additions to factory to Hoeppner-Bartlett Co., 631 East Madison St., Eau Claire.

Rubber Factory—Goodyear Tire & Rubber Co., 1144 East Market St., Akron, O., has awarded contract for first unit of factory at St. Mary's, O., to Clemmer Construction Co., Cordelia Ave., Akron., $350,000; total estimated cost of project $1,000,000.

Chemical Warehouse—Monsanto Chemical Co., 1700 South Second St., St. Louis, Mo., has awarded contract for 1 story, 60x140 ft. warehouse at 152 West Lesperance St., and 1 story, 50x62 ft. warehouse at 2000 Kosciusko St., St. Louis, to Fruin-Colnon Contracting Co., 502 Merchants Laclede Bldg., St. Louis. $40,000.

Cement Storage Bins—Alpha Portland Cement Co., 16 South Third St., Easton, Pa., has awarded contract for cement storage bins to Nicholson Co., 405 Lexington Ave., New York, N. Y. Cost will exceed $100,000.

Storage and Distributing Plant—Standard Oil Co. of Indiana, 910 South Michigan Ave., Chicago, Ill., has awarded separate contracts for construction of storage and distributing plant. Cost will exceed $200,000.

Storage Tanks—Semet Solvay Co., River Rd., Tonawanda, N. Y., will construct gas storage tanks by separate contracts. $150,000.

Warehouse—Onondago Pottery Co., 1858 West Fayette St., Syracuse, N. Y., will build 1 story, 35x175 ft. warehouse with own forces.

Warehouse—Socony-Vacuum Oil Co., Wadhams Division, 907 South First St., Milwaukee, Wis., has awarded contract for warehouse and service buildings at La-Crosse, Wis., to W.M.C., Inc., 264 West 7th St., Winona, Minn.

DISRUPTION OF BELLIGERENT NATIONS EXPORT TRADE AFFECTS DOMESTIC CHEMICAL INDUSTRY

GERMANY'S position at the outbreak of the present war was unique. Largely due to rearmament, her share in total world production rose from 8.3 per cent in 1932 to 15 per cent by the middle of 1939 (including new territories). In 1938, however, only 10.9 per cent of Germany's total industrial output was exported, against 28 per cent in 1932. Her share in total world trade rose slightly from 9.5 per cent in 1932 to 10.4 per cent in 1938, placing her behind Great Britain and America.

One of the largest items in Germany's export trade has been chemicals. According to preliminary figures for 1938, German chemical exports were valued at $263,300,000 as against $158,500,000 for the United States, while Germany's chemical imports were valued at only $84,200,000 as against U. S. chemical imports of $146,000,000. The estimated value of German chemical production in 1938, including Austrian production (excluding staple fiber and synthetic rubber but including mineral oil refining) was 6,000 million RM. The value of German chemical exports dropped by 16 per cent from 1937 to 1938, although the value of imports from the United States into Germany advanced over 1937, chiefly due to larger arrivals of phosphate rock, refined borax, and sulphur. Exports from Germany to the United States in the last year declined by nearly one-third in all chemical items, except heavy coal-tar oils and potassium chlorate.

The implication for the chemical as well as other industries of Germany being cut off from her overseas markets is clear. The loss of Germany's premier position in world chemical trade, temporarily if not permanently, seems to be a likely outcome of the war. Although prognostications at this point are difficult, it also seems probable that the chemical industry of the United States will inherit a large part of Germany's as well as Britain's trade—assuming that Japan is not in a position to take over a large part of the Reich's former trade. Past experience indicates the possible course of events. Whereas Germany controlled 88 per cent of the world's dye trade at the outbreak of the World War and dominated the chemical field, the disruptions in trade and subsequent industrialization of former importing countries caused Germany losses which were recovered only with great difficulty when the conflict was over, and some of the losses were never regained. In South America for instance, while the trade of belligerents dwindled after 1914, United States sales doubled. Afterwards, however, the advantage was not maintained. This time, in spite of chaotic exchange conditions and limited buying power in many South American countries, it seems possible for the United States to absorb a large part of Germany's trade. If experience has taught anything, care will probably also be taken to see that the trade is established on a sound enough basis that, once captured, it may be retained.

According to data compiled by the Department of Commerce, German shipments to North and South America accounted for about 20 per cent, or $52,000,000 of all Germany's chemical exports. Latin America, including Mexico and the Caribbean area received products valued at $32,000,000, the balance going to the United States and Canada.

Approximately 50 per cent of the chemical shipments to Latin America consisted of medicinals; 18 per cent of coal-tar products; 5 per cent of photographic chemicals; 5 per cent of explosives; and 4 per cent of fertilizer materials, mainly potash and nitrates. The Latin American trade was chiefly with Brazil, Argentina, Mexico, Colombia and Chile. These five countries purchased about 80 per cent of the total shipments, other exports going to Peru, Uruguay, Venezuela, Cuba and Bolivia.

United Kingdom Exports

The United Kingdom has made considerable progress as a supplier of chemicals and related products to Latin American countries in recent years, particularly to the Republics of Argentina, Chile and Brazil. In 1938 shipments of such products from the United Kingdom to Latin American countries, including Mexico, Central America and the Caribbean area were valued at about $9,300,000, which was slightly less than the value of such shipments from France to these areas.

Argentina was the largest purchaser of British chemicals and related product last year, taking goods valued at more than $4,000,000, which consisted mainly of sodium compounds, and animal dips; followed by Brazil with products valued at $2,300,000, 50 per cent of which consisted of sodium compounds, the balance being made of medicinals, paints, and miscellaneous chemicals; and Chile, $723,000.

Other leading markets for British chemicals and related products last year, included Mexico with purchases valued at $353,000; Uruguay, $365,000; Colombia, $332,000; Cuba, $269,000; Haiti, $242,000; Peru, $244,000; and Venezuela, $223,000.

Approximately one-third of all British chemicals and related products shipped to Latin American areas last year, or products valued at $3,000,000, consisted of sodium compounds; shipments of paint products were valued at $1,400,000; disinfectants and insecticides (mainly animal dips to the Argentine), $1,300,000; medicines and pharmaceuticals, $418,000; and soaps, $338,000. The balance of British chemicals and related products sold to Latin American countries last year consisted of a wide line of products, including waxes, heavy chemicals and chemical specialties.

Consideration of the effect upon the domestic chemical industry which will follow the cutting down or elimination of imports, centers on selective items which either are not produced in this country or are not turned out in sufficient volume to satisfy consuming requirements.

Despite the development of a home potash industry in recent years, statistics for German export trade in 1938 include the following totals for potash salts shipped to this country: raw potash salts, 15,405 metric tons; sulphate of potash, 129,942 metric tons; nitrate of potash, 12,589 metric tons; chlorate of potash, 5,230 metric tons; and caustic potash, 423 metric tons.

Domestic production will be speeded up to meet the present situation and the renewal of operations at Spanish mines may contribute further to our supplies. So far as the fertilizer trade is concerned, ample potash stocks are expected to be available. Limitations of domestic refinery capacities, however, give some concern regarding offerings of the higher grade salts for chemical manufacture.

Chlorate of potash, which has not been made in this country in recent years, already has reached the stage where it is difficult to obtain supplies and import probabilities are not such as to encourage the belief that this market condition will change for the better in the near future. More encouraging are reports that domestic manufacture of chlorate may soon get underway.

Rapid growth of kraft pulp production in this country with a consequent increase in consumption of salt cake has brought salt cake into a more prominent place in our import trade. The major part of such imports has come from Germany and with this source of supply cut off, there rises the problem of tapping new sources. Shipments of sodium sulphate from Germany to this country last year amounted to 76,117 metric tons—approximately 84,500 short tons. Total imports of salt cake into this country last year were reported at 142,429 short tons of which Chile contributed 26,079 short tons. Consumption of salt cake this year has been at a rate higher than a year ago and a sharp rise in domestic output and possibly larger imports from Chile will be necessary if consumers are not to feel the loss of supplies which were expected to come from Germany.